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Battery Test Facility Hardware, Software, and System Operation

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Battery Test Facility
Hardware, Software, and System Operation

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Abstract

This report describes the Battery Test Facility in operation at Sandia National Laboratories. The test facility is used to evaluate various battery technologies. The report includes a detailed hardware description, software description, and system operation procedures.

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Hardware, Software, and System Operation

1.0 Introduction

Division 2525 Battery Test Laboratory is a fully automated battery testing facility used in evaluating various battery technologies. The results of these tests are used to verify developers' claims, characterize prototypes, and assist in identifying the strengths and weaknesses of each technology.

The Test Facility consists of a central computer and nine remote computer controlled battery test systems. Data acquired during the battery testing process is sent to the central computer system. The test data is then stored in a large database for future analysis. The central computer system is also used in configuring battery tests. These test configurations are then sent to their appropriate remote battery test sites.

1.1 Battery Tests Available within the Test Facility

The Battery Test Facility can perform a variety of battery tests, which include the following:

- Life Cycle Testing
- Parametric Testing at various temperature levels, cutoff parameters, charge rates, and discharge rates.
- Constant Power Testing at various power levels.
- Peak Power Testing at various State-of-Charge levels.
- Simplified Federal Urban Driving Schedule Tests (SFUDS79).

The Battery Test Facility is capable of charging a battery either by constant current, constant voltage, step current levels, or any combination of them. Discharge cycles can be by constant current, constant resistance, constant power, step current levels, or also any combination of them.

1.2 Hardware Capabilities

The Battery Test Facility has been configured to provide the flexibility to evaluate a large variety of battery technologies. These technologies include Lead-Acid, Sodium/Sulfur, Zinc/Bromine, Nickel/Hydrogen, Aluminum/Air, and Nickel/Cadmium batteries.

There are presently 50 battery test stations configured into the test facility network. Each test station operates independently, containing its own charger, load unit, and data acquisition/control channels. Of the 50 test stations, 48 are configured into groups of six test stations. Each group of battery test stations, along with its associated hardware are referred to as a Line Unit (LU). LU numbers range from 23 through 30.

The following is a list of battery test hardware limitations associated with each LU.

LU 23: Stations 1 through 6
Charge: 0 to 40 Volts, 0 to 30 Amps
Discharge: 0 to 55 Volts, 0 to 75 Amps,
750 Watts Maximum

LU 24: Stations 1 through 6
Charge: 0 to 40 Volts, 0 to 30 Amps
Discharge: 0 to 55 Volts, 0 to 75 Amps,
750 Watts Maximum

LU 25: Stations 1 through 6
Charge: 0 to 10 Volts, 0 to 100 Amps
Discharge: 0 to 100 Volts, 0 to 100 Amps,
5K Watts Maximum

LU 26: Stations 1 through 6
Charge: 0 to 40 Volts, 0 to 30 Amps
Discharge: 0 to 55 Volts, 0 to 75 Amps,
750 Watts Maximum

LU 27: Stations 1 through 4
Charge: 0 to 40 Volts, 0 to 30 Amps
Discharge: 0 to 55 Volts, 0 to 75 Amps,
750 Watts Maximum

Stations 5 and 6.
Charge: 0 to 100 Volts, 0 to 200 Amps
Discharge: 0 to 100 Volts, 0 to 200 Amps,
5K Watts Maximum

LU 28: Stations 1 through 6
Charge: 0 to 40 Volts, 0 to 30 Amps
Discharge: 0 to 55 Volts, 0 to 75 Amps, 750 Watts Maximum

LU 29: Stations 1 through 6
Charge: 0 to 20 Volts, 0 to 50 Amps
Discharge: 2 to 55 Volts, 0 to 50 Amps, 1K Watts Maximum

LU 30: Stations 1 through 5
Charge: 0 to 40 Volts, 0 to 30 Amps
Discharge: 0 to 55 Volts, 0 to 75 Amps, 750 Watts Maximum

Station 6
Charge: 0 to 146 Volts, 0 to 100 Amps
Discharge: 0 to 110 Volts, 0 to 100 Amps, 10K Watts Maximum

Portable Battery Test System
Charge: 0 to 40 Volts, 0 to 30 Amps
Discharge: 0 to 55 Volts, 0 to 100 Amps, 1.5K Watts Maximum

50K Watt Battery Test System
Charge: 0 to 20 Volts, 0 to 900 Amps
Discharge: 2 to 100 Volts, 0 to 900 Amps, 50K Watts Maximum

1.3 Environmental Test Capabilities

The Battery Test Facility can test battery technologies at various temperature ranges using environmental chambers and high temperature furnaces.

Three environmental chambers are configured into the Test Facility. At LU27 there are two, each with an operating range from -73 to 200 °C. LU28 contains one chamber with a operating range from -80 to 177 °C.

With the advent of Sodium/Sulfur battery testing, several high temperature control systems have been developed. These systems consist of programmable temperature controller/SCR units and Marshall™ high temperature furnaces. Each control unit is capable of several temperature ramp functions and set points. The Battery Test Facility is configured with 24 of these high temperature stations. Each station is capable of operating from ambient to 1000 °C.

1.4 Exhaust Hoods

During the battery testing process, some battery technologies emit hazardous fumes. To vent these fumes, testing is performed inside one of several exhaust hoods located throughout the battery test facility.

2.0 System Description

2.1 Computer Network Configuration

The Battery Test Facility consists of 8 battery test LUs. Each LU is controlled by a HP9000 Series 310 computer. Figure 1 contains a pictorial diagram of a typical LU. All LUs are linked to the central computer system. The central computer consists of a HP1000 A-Series computer and its associated mass-storage devices. Figure 2 shows a pictorial diagram of the central computer system.

2.2 Interface Link

All computers contained within the Battery Test Facility are linked together through the HP-IB interface bus (IEEE-488 1978 standard). The HP1000 computer performs as the HP-IB bus controller and the HP9000 computers as slave devices. Each computer on the bus is assigned a unique bus address. The HP1000 computer is assigned a HP-IB address of 36. LU23 an address of 1, LU24 an address of 2, and so on through LU30 with an address of 8.

2.3 HP-IB Bus Extenders

The physical distance between the computer systems exceeds the maximum allowed under the IEEE-488 standard. To overcome this limitation, HP-IB bus extenders have been installed at each computer location. HP-IB bus extenders allow remote devices to be extended to over 1250 meters. Each HP-IB bus extender is linked together through fiber optic cables. The use of fiber optic cables also provides electrical isolation between computer systems.

2.3.1 HP37204 HP-IB Bus Extender

The HP37204 bus extender is the device used through the test facility to interface the computer systems. Located on the front panel of this device are three indicator lamps and a switch. The switch is a three position slide switch labeled MASTER, MIDDLE, and END. In the HP-IB network, there is one MASTER and one END HP-IB bus extender. The "MASTER" bus extender is connected to the HP1000 computer and the END bus extender at LU25. All in-between HP-IB bus extenders are set to MIDDLE. Figure 3 identifies the location of each HP-IB bus extender within the battery test facility.

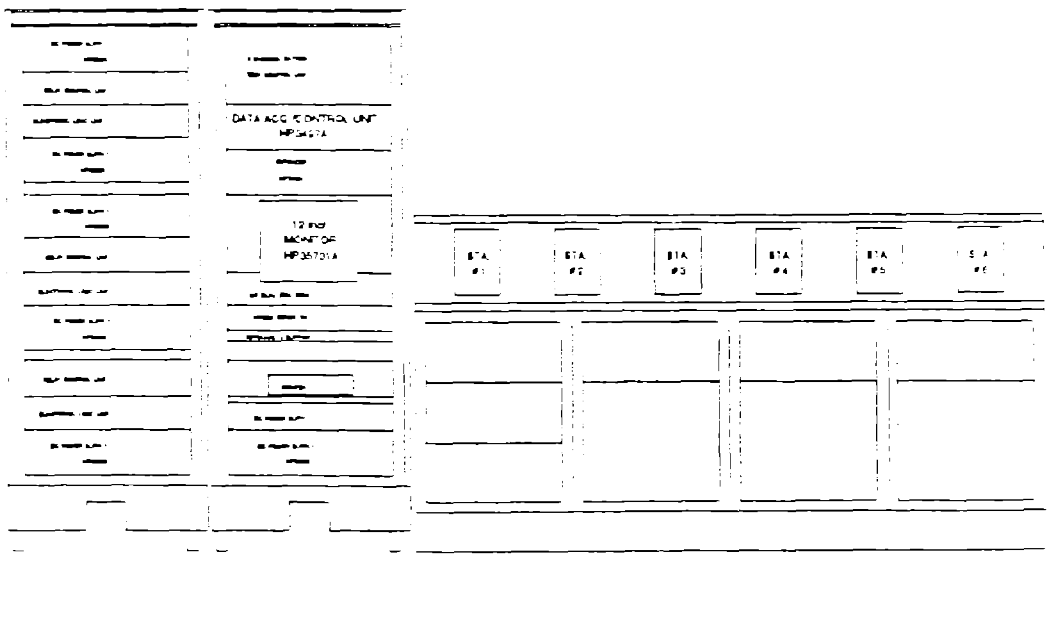


Figure 1. Typical Battery Test Line Unit

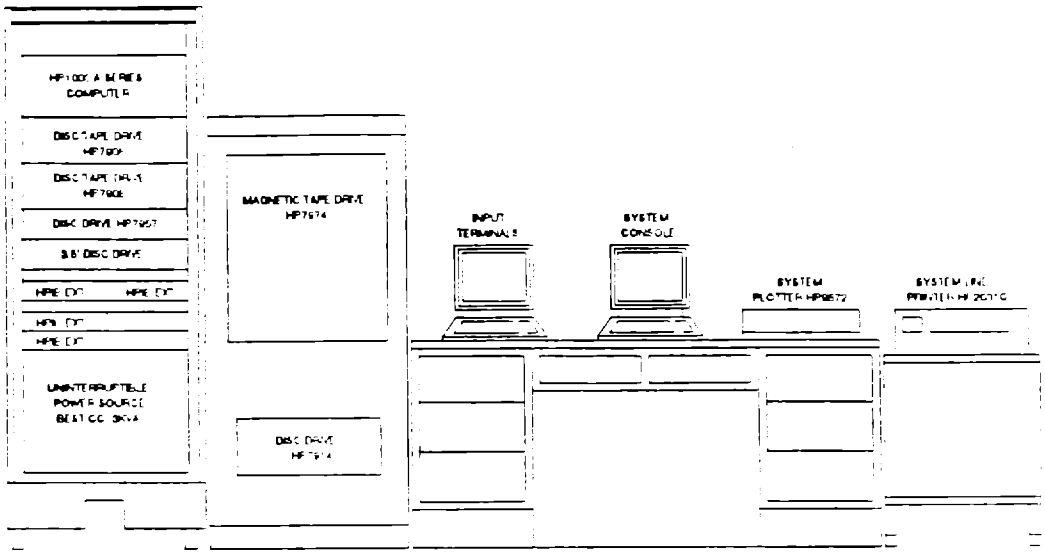


Figure 2. Central Computer System

Located on each HP-IB bus extender's back panel are three I/O connectors, labeled PORT A, PORT B, and HP-IB. The back panel also contains a dip switch, used in selecting I/O ports for data transmission. All HP-IB bus extenders in this system will have switches four and five set in the UP position. This selects the fiber optic ports labeled PORT A and PORT B for data transmission. Each port has a TX (transmit) and RX (receive) fiber optic connector.

The I/O connector labeled HP-IB is connected to the computer's HP-IB interface card. The fiber optic link between each bus extender is shown in Figure 4. Note that the TX port of a bus extender is connected to the RX port of the next bus extender and the TX port of that bus extender connect to the RX port of the previous.

2.4 Central Computer System

The Battery Test Facility centers around the HP1000 A600 computer system operating under the RTE-A environment. The HP1000 A600 computer is based on a distributed intelligence concept that separates the processing of input/output (I/O) instructions from that of other instructions. The Central Processor Unit (CPU) resides on a single printed circuit board and features a fully microprogrammed bit-slice control processor, which executes one million instructions per second (.6 MIPS). The RTE-A operating system is a real-time multitasking, multiuser environment. The operating system supports program development in FORTRAN 77, Pascal, BASIC, and Micro/1000 assembly language.

Physically, the HP1000 computer system is configured with four 512K byte memory cards, one memory processor card, one A600 CPU card, three HP-IB interface cards, one system console card, and a RS-232 mux card. All cards are contained in a 20 slot computer chassis. Figure 5 shows the location of each card within the 20 slot computer chassis. The HP1000 computer system is configured with 247 megabytes of mass-storage space and 2048K bytes of memory.

Figure 5 shows a simplified diagram of all devices associated with the central computer system.

Every device associated with the HP1000 computer is identified during system generation time. Once the operating system is generated and the system booted, a listing of all these devices can be obtained. Table 1 lists the devices presently configured into the HP1000 computer system. Note that each individual device has a device unit number (DU), HP-IB select code, and device address assignment.

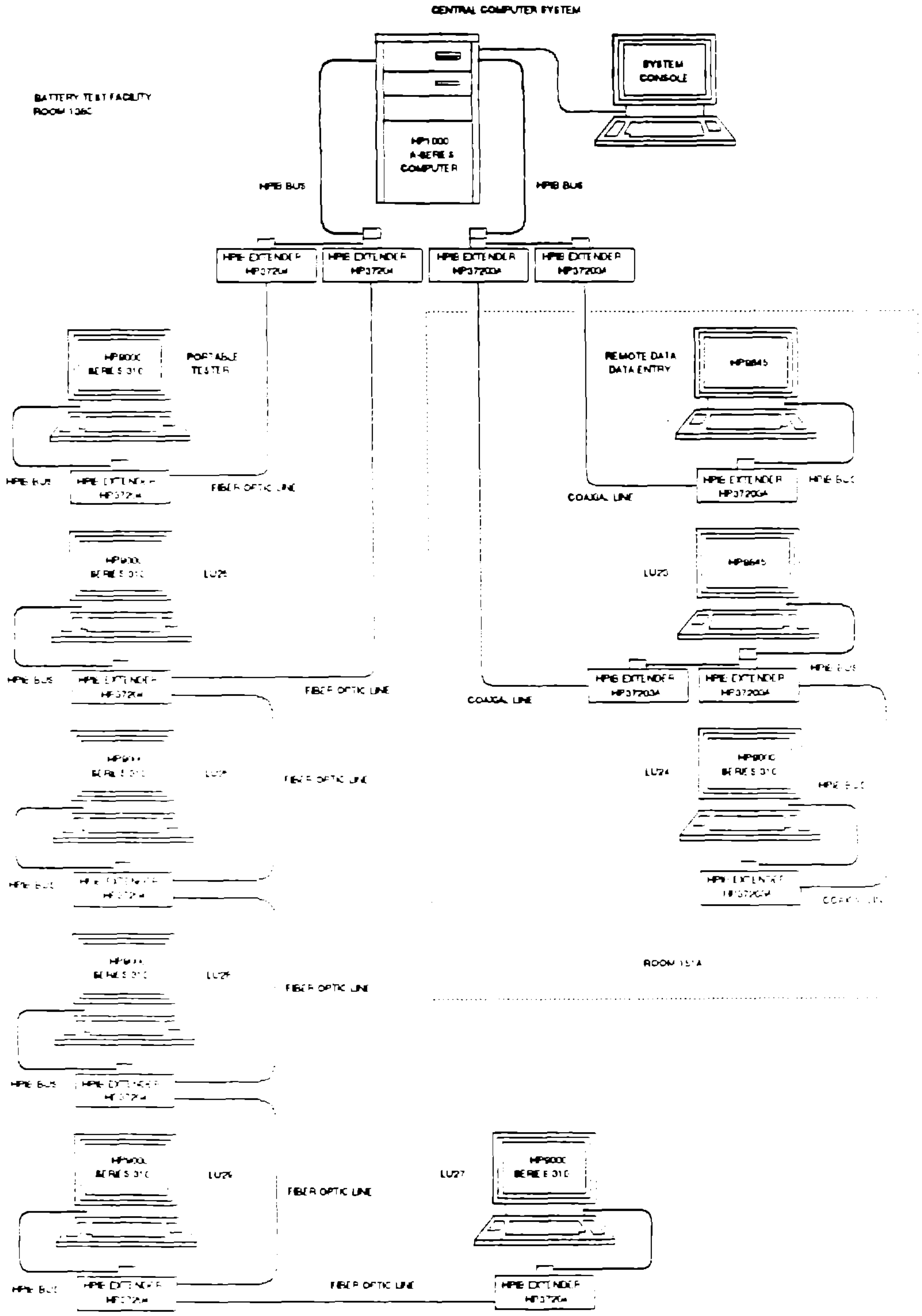


Figure 3. Locations of HP-IB Extenders Within Computer Network

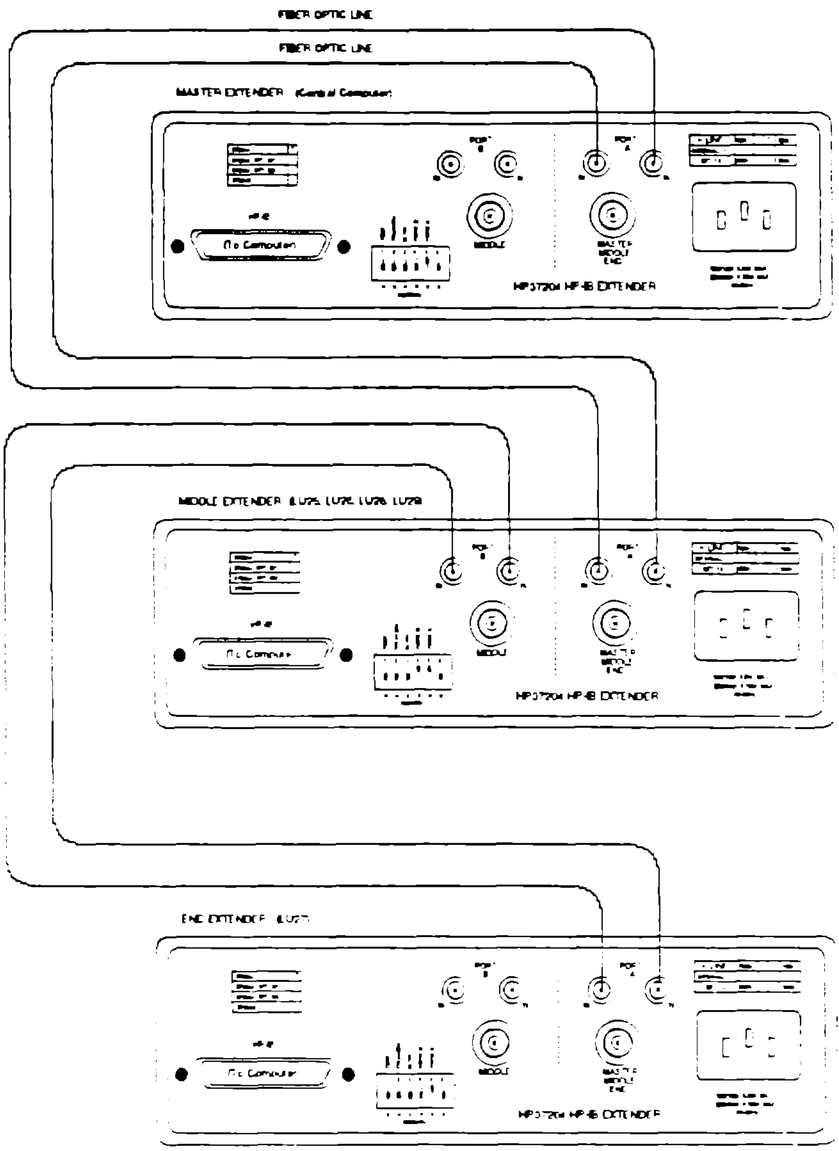


Figure 4. Fiber Optic Cable Connections Between HP-IB Extenders

2.5 Line Units

2.5.1 HP9000 Series 310 Computer System

The Battery Test Facility consists of eight LUs. Each LU is controlled by an HP9000 Series 310 computer. The computer operates off the 89561-66525 processor board. This processor board features the MC68010 microprocessor, which operates at 10 Mhz. Additional features include the following:

- 1 megabyte of memory
- 1 RS-232 I/O port and 3 HP-IB interface ports
- HP35731A 12-inch monochrome display
- HP46021A keyboard
- HP9122C dual 3.5" flexible disc drive.

2.5.2 Major Components of a Typical Line Unit

A typical LU consists of the following.

- HP9000 Series 310 computer system
- HP3497A data acquisition/control unit
- 9-channel battery test control unit

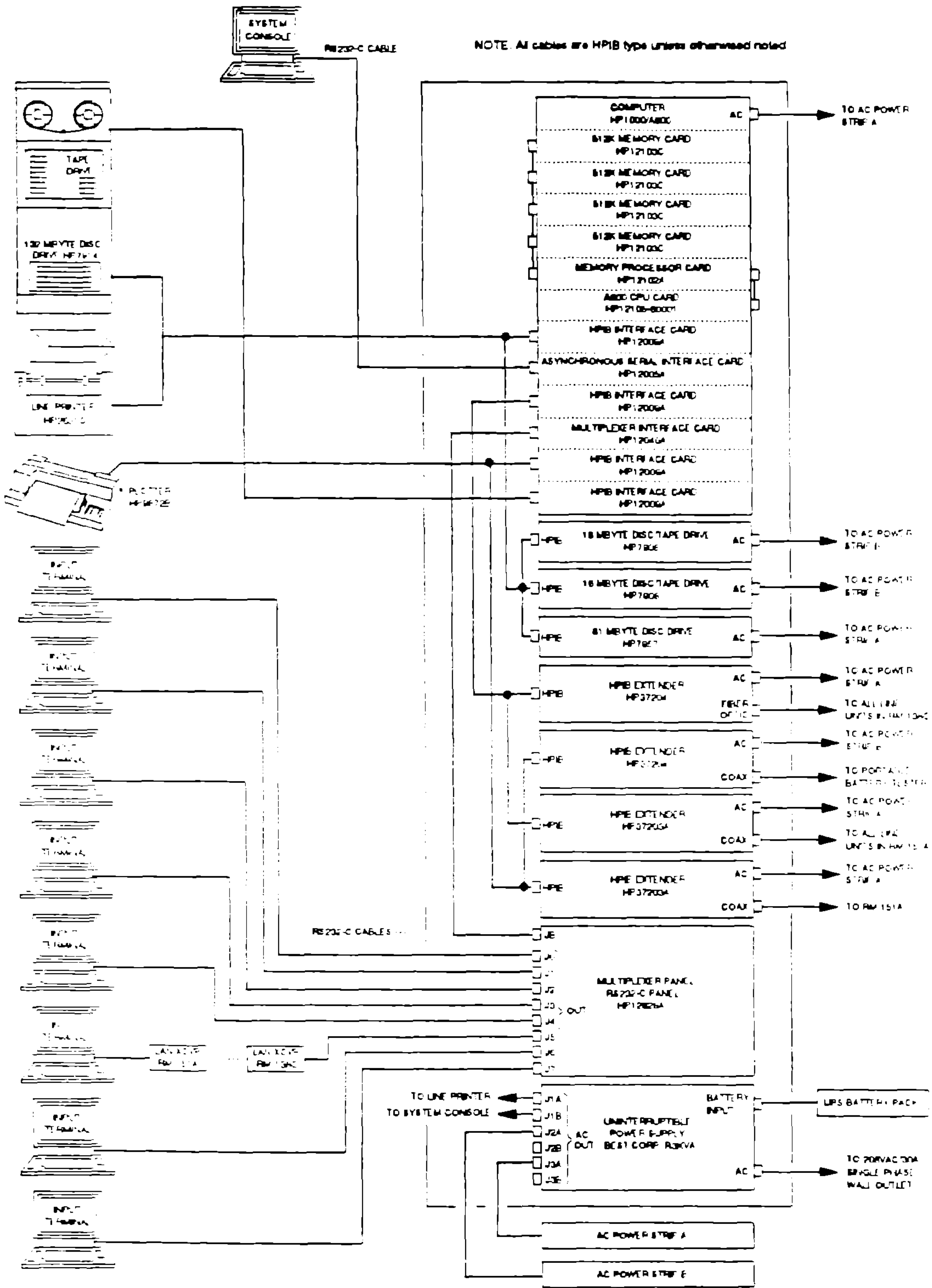


Figure 5. Simplified Diagram of All Devices Associated with Central Computer System

Table 1. Device Configuration Table for HP1000 Computer

DU Number	Device Type	Select Code	HP-IB Address	Card Location
1	System console	20	—	slot 7
2	CS80 Disc Drive HP7914	27	3	
3	CS80 Disc Drive HP7914	27	3	slot 6
4	CS80 Disc Drive HP7957	27	4	slot 6
5	——			
6	System Line Printer	27	6	slot 6
7	——			
8	Mag Tape Drive	33	3	slot 11
9	HP-IB Bus Controller	27	36	slot 6
10	Floppy Disc	27	5	slot 6
11	Floppy Disc	27	5	slot 6
—				
16	CS80 Disc Drive HP7908	27	0	slot 6
17	CS80 Disc Drive HP7908	27	2	slot 6
18	CS80 Disc Drive HP7908	27	2	slot 6
—				
21	CS80 Tape Drive HP7908	27	2	slot 6
22	HP-IB Bus Controller	30	36	slot 8
23	HP9000 Series 310	30	1	slot 8
24	HP9000 Series 310	30	2	slot 8
25	HP9000 Series 310	30	3	slot 8
26	HP9000 Series 310	30	4	slot 8
27	HP9000 Series 310	30	5	slot 8
28	HP9000 Series 310	30	6	slot 8
29	HP9000 Series 310	30	7	slot 8
30	HP9000 Series 310	30	8	slot 8
—				
33	HP-IB Bus Controller	32	36	slot 10
34	HP9000 Series 310	32	2	slot 10
35	HP87 Computer	32	3	slot 10
36	HP9872 Plotter	32	4	slot 10
37	HP9845 Computer	32	5	slot 10
—				
40	HP-IB Bus Controller	33	36	slot 11
—				
45	CS80 Tape Drive	27	2	slot 6
—				
71	Remote Terminal Rm151A	23	mux ch.1	slot 9
72	Terminal HP150	23	mux ch.2	slot 9
73	Terminal HP2397 color	23	mux ch.3	slot 9
74	Terminal HP150	23	mux ch.4	slot 9
75	Terminal HP150	23	mux ch.5	slot 9

- 3 dual-channel high current control units
- 6 HP6268B DC power supplies
- 3 dual-channel AC/DC electronic load units
- I/O patch panel.

Shown in Figure 6 is a simplified drawing of the hardware device contained within a typical LU. The following is a brief description of all major devices contained in an LU.

2.5.2.1 Test Controller

The HP9000 Series 310 computer servers as the test controller for the LU. The computer executes software that controls all battery testing operations for the LU. These operations include switching each battery between charge and discharge test modes; performing test measurements; controlling test cutoff parameters; and maintaining alarm monitoring. The computer also contains various software routines that allow for communication with the HP1000 computer system.

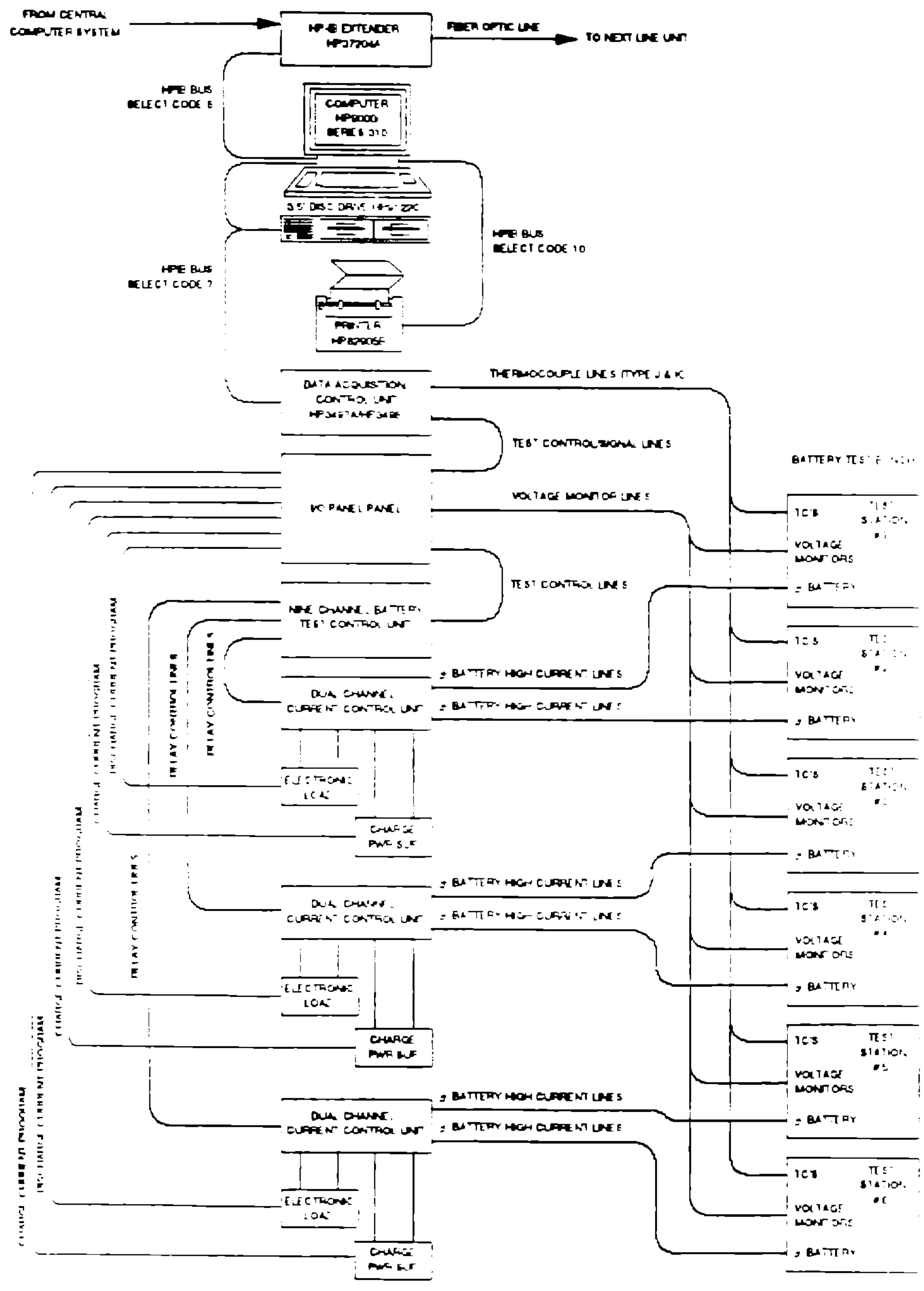


Figure 6. Simplified Drawing of All Devices Associated with a Typical Line Unit

2.5.2.2 Data Acquisition/Control System

The HP3497A data acquisition/control unit's primary function is to act upon commands sent from the test controller. This unit performs the actual test measurements, controls the charge and discharge test currents, and the operation of all high current contactors in the system. This unit consists of a front panel keyboard/display, a real-time clock, HP-IB interface, voltmeter, and 5 I/O slots in which a variety of plug-in assemblies can be installed. The capabilities of the HP3497A have been expanded by the addition of HP3498A extender chassis. The HP3498A contains 10 additional I/O plug-in slots. The location and type of each plug-in assembly are shown in Figure 7.

The following is a brief description of each plug-in assembly used by the HP3497A Acquisition/Control unit:

- HP44421A 20 Channel Guarded Acquisition: This assembly uses reed relays to multiplex signals to the DVM. Each channel consists of HI, LO, and GUARD input lines.
- HP44422 20 Channel T-couple Acquisition: This assembly uses reed relays to multiplex signals to the digital voltmeter. Each channel consists of HIGH, LOW, and GUARD inputs. This assembly also incorporates a special isothermal connector block to allow thermocouple compensation. A thermistor is located on channel 19 of this assembly. The thermistor monitors the temperature of the card and is also used to correctly calculate thermocouple readings. All thermocouple types may be connected to the assembly.
- HP44428A 16 Channel Actuator Output: This assembly consists of 16 mercury wetted form-C single pole-double throw relays. Each relay functions individually and can safely switch 1 Amp at 100 Volts DC.
- HP44429A Dual Voltage D/A: This assembly consists of two 0 to +10 Volt programmable voltage sources each with a maximum current output of 15ma. These assemblies are used to control the remote current programming inputs of each test station's charger and load units.

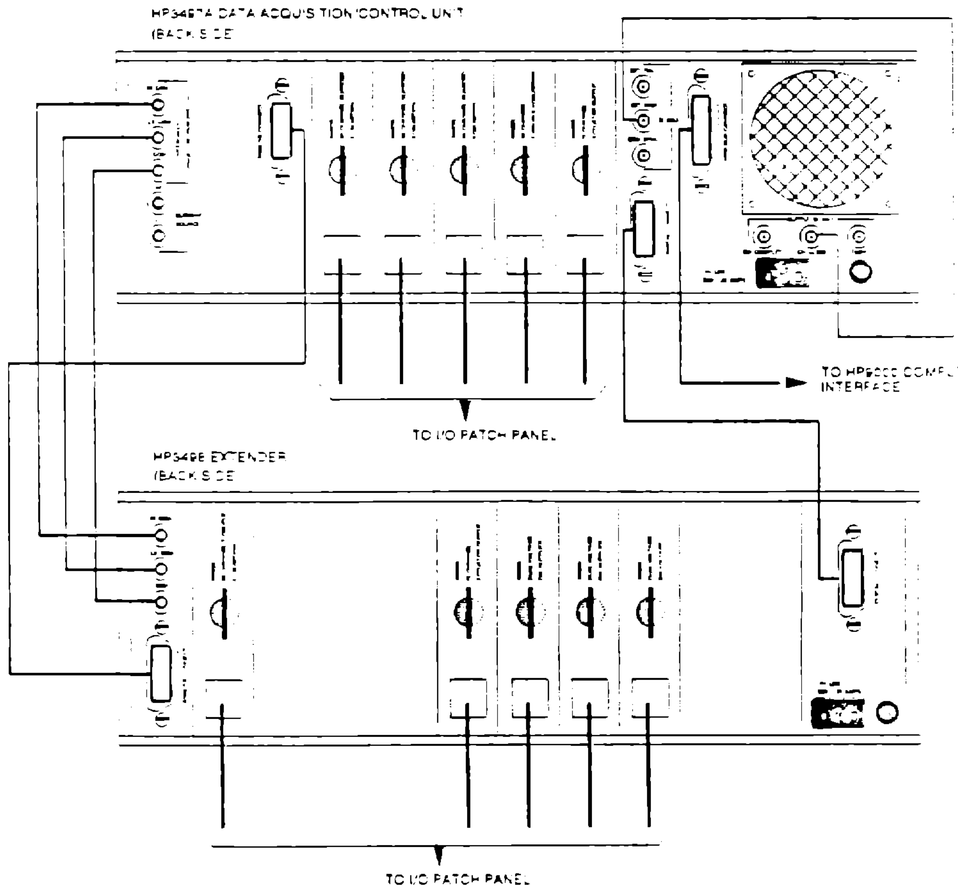


Figure 7. HP3497A and HP3498 Plug-in Card Assembly Locations and Interconnects

2.5.2.3 Nine Channel Battery Test Control Unit

The nine channel battery test control unit controls the operation of the high current contactors for up to nine test stations. The unit also contains several battery testing safety features. Features that check for high/low battery voltage levels, high test current levels, and for test controller (HP9000 or HP3497A), software lockup conditions.

2.5.2.4 Dual Channel Relay Chassis

The dual channel current control unit contains several high current contactors that switch battery test currents between DC power supplies during charge periods and electronic load units during discharge periods. The unit provides two modes of operations, SINGLE and COMBINE. In the SINGLE mode of operation, the battery is directly connected to the electronic load unit during discharge periods. This is used when testing batteries with an operating voltage greater than 4 Volts. In the COMBINE mode of operation, the charge mode power supply is connected in series with the electronic load unit during discharge periods. This is used when testing batteries with voltages less than 4 Volts. See Drawing section for chassis layout and electrical schematics.

2.5.2.5 Battery Charging Unit

The battery charging units for most test systems utilize HP6268B, 0-40 Volt, 0-30 Amps supply. In some systems, the HP6260B, 0-10 Volt, 0-100 Amp supply is used.

2.5.2.6 Battery Load Unit

The battery load units for most test systems utilize AC/DC Inc.'s dual channel electronic load units. These units have a current range from 0 through 200 Amps, with a maximum power dissipation of 750 Watts. In some test systems where higher power levels are needed, Digitec's 5 kilowatt electronic loads are used.

3.0 Software Descriptions

The following sections describe the software programs that are used by the Battery Test Facility. The descriptions are intentionally brief and are included as a guide to help understand the structure of the programs. For a complete discussion of the software capabilities of the HP1000 and HP9000 computer systems, the reader should refer to the appropriate programmers reference manuals furnished by Hewlett-Packard.

The Software for the Battery Test Facility is categorized into two groups. The first group contains software that resides in the HP9000 computers. The second group contains software that resides in the HP1000 computer. All the software in the first group has been combined into one large program called NEWBT. This program contains approximately 5000 lines of code developed in BASIC 5.1. NEWBT contains software routines that control all battery testing operations for a Line Unit (LU). The second group contains software programs CONFIG, DATR3, NPLOT, and DBPLOT. The software in this group has been developed in FORTRAN. The following sections briefly describe these software programs.

3.1 Battery Test Program NEWBT

NEWBT is a software program that controls all battery test operations. This program is written in HP Basic 5.1 for the HP9000 Series 310 computers. NEWBT allows the operator to execute any of several battery tests listed in Section 1.1. In addition, NEWBT allows the operator to configure a battery test locally (at test controller) or remotely (by receiving it from the central computer). Options for real-time plots of any test parameter verses time are also available. The heart of the operation for the NEWBT program lies within the Battery Test Configuration Table and the Cycle Timer Table.

3.1.1 Battery Test Configuration Table

The Battery Test Configuration Table contains entries that identify the following for each battery under test:

- Battery identification number
- Identifies battery manufacturer
- Amp-hour rating of battery
- Present test mode of battery
- Test measurement scanner channels
- Test measurement multiplication factors
- Delta store percentages
- Test measurement values high and low alarm levels
- High current contactor actuator channels

Table 2 lists an example of the contents of a typical Battery Test Configuration Table for a battery under evaluation. There are six such tables per LU that correspond to the six test stations available on each LU.

The following describes in detail each entry contained with in the Battery Test Configuration Table:

ID # — A numeric value assigned to the battery used in identifying the battery throughout its test life

Manufacturer — Contains the name of the battery manufacturer and its manufacturer identification number.

Nominal Amp-hour Rating — The capacity rating of the battery.

Test Mode — Indicates the present test mode of the battery.

Channel — These entries correspond to a scanner channel located within the HP3497A Data Acquisition/Control unit. The prefix "V" signifies a voltage reading, prefix "A" a current reading, and prefix "T" a temperature reading. The suffixes "-K" or "-J" indicate type of thermocouple used. A "-1" entry signifies an inactive scanner channel.

Multi. Factor — These entries contain both scanner reading multiplication factors and delta data storage factors. The scanner multiplication factor is located to the left of the "-" and to the right the delta data storage factor. The scanner channel measurement reading is multiplied by the scanner multiplication factor. The delta data storage factor triggers a record of test data measurements to be saved. For example, when the present scanned reading exceeds the last stored reading by this percentage, the present data is saved.

High Limit — These entries contain high alarm values for corresponding scanner channel readings. If this value is exceeded, the battery is placed in an open circuit state and its test mode is changed to MONITOR.

Table 2. Battery Test Configuration Table

ID #	Manufacturer	Nominal Amp-hr Rating		Test Mode
489	Exxon VT113	120		MONITOR
Position	**Channel**	**Mult. Factor**	**High Limit**	**Low Limit**
1	V0	1-.05	10	1
2	A1	1000-.05	50	0
3	T82-K	1-.05	45	10
4	V2	1-.05	3	.7
5	V3	1-.05	3	.7
6	V4	1-.05	3	.7
7	-1	1-.05	100	0
8	-1	1-.05	100	0
9	-1	1-.05	100	0
Connect/Discon	Charge/Disch	Cycle Timer	# of Cycles	
0	1	0	1	

Low Limit — These entries contain low alarm values for corresponding scanner channel readings. If this value is greater than test measurement, the battery is placed in an open circuit state and its mode is changed to MONITOR.

Connect/Discon — This entry corresponds to relay actuator channel within the HP3497A data acquisition/control unit. If this relay is de-energized, the battery is in an open circuit state. If this relay is energized, test current is allowed to flow through the battery.

Charge/Discharge — This entry corresponds to a relay actuator channel within the HP3497A data acquisition/control unit. If this relay is de-energized and the connect/disconnect relay is energized, the battery is placed across the charge power supply. If this relay is energized, and the connect/disconnect relay is energized the battery is placed across the load unit for discharging.

Cycle Timer — This entry contains the number of minutes the battery has been on a particular test period.

# of Cycles — This entry contains a value equal to the number of test cycles left to perform.

3.1.2 Cycle Timer Table

The Cycle Timer Table contains test periods (modes) that form a test cycle. There can be a maximum of 12 test periods in a test cycle. The following are valid test periods entries: INIT WAIT, INIT CHARGE, INIT DISCHG, WAIT, CHARGE, DISCHARGE, POWER, PEAKPWR, STRIP, and SHORTOUT. Test periods with the prefix INIT are performed only on the first cycle of a cycle set. There can be multiple WAIT, CHARGE, DISCHARGE, POWER, and PEAKPWR periods within a test cycle. Numeric values following test period entries are used in keeping track of which test period is to be executed.

Each test period contains a corresponding set of test parameters. Test period parameters determine test period lengths and cutoff values. Detailed descriptions of test parameters are discussed later in the report. Table 3 lists an example of a typical Cycle Timer Table. Each battery under test has its own Cycle Timer Table.

3.1.3 Battery Test Data Records

During the battery testing process, test data is acquired and stored on the LU's mass storage device. The test data is configured into a 16 element record before being stored. The first element of a data record contains the battery identification number and test flag, which identifies the test mode. Test flag definitions will be discussed later in this report. The second and third elements of a data record

Table 3. Cycle Timer Table

Present Cycle Timer Config		New Cycle Timer Config	
Modes	**Times**	**Modes**	**Times**
WAIT1	5	——	
DISCHARGE1	146-10V5	——	
WAIT2	5	——	
CHARGE1	150-10%5	——	
STRIP1	999-16	——	

contain the date and time this data was generated. The date element is in a MMDDYY format and time in a HHMMSS format. The fourth and fifth elements contain the battery voltage and test current. Elements 6 through 9 contain Amp hour removed, Watt hour removed, Amp hour returned, and Watt hour returned values. The values for these elements are calculated and accumulate during the testing process. Record element 16 contains the battery temperature as identified in the Battery Test Configuration Table. The contents of elements 10 through 15 depend upon the scanner channel types identified in positions 4 through 10 of the Battery Test Configuration Table. Table 4 lists this structure and identifies each element of a data record.

Battery data records are stored on data discs contained within the LU's mass-storage unit. These data discs are created prior to running battery tests. There should always be a good supply of new 3.5" data discs on hand.

The battery data discs contain two data files, called DATA and POINT. DATA is created with 4800 fixed length data records. POINT contains two 16-bit numeric variables. The first variable is referred to as the L pointer. It is used to record the number of data records presently stored on the data disc. The second variable contains the N pointer. This pointer is set equal to the number of data records created on the disc, normally 4800.

As each data record is stored onto the disc, the L pointer is increased by one. When this pointer reaches the value of the N pointer minus 15, the data disc is said to be full.

3.1.4 Flowchart of NEWBT

Figure 8 contains a simplified flowchart of the NEWBT software program. The software can be divided into three

Table 4. Structure of a Battery Data Record

Element	Description
1	Battery Identification number and Test Flag
2	Date (format MMDDYY)
3	Time (format HHMMSS)
4	Battery Voltage
5	Battery Current
6	Amphours Removed (calculated)
7	Watthours Removed (calculated)
8	Amphours Returned (calculated)
9	Watthours Returned (calculated)
10	User Defined
11	User Defined
12	User Defined
13	User Defined
14	User Defined
15	User Defined
16	Battery Temperature

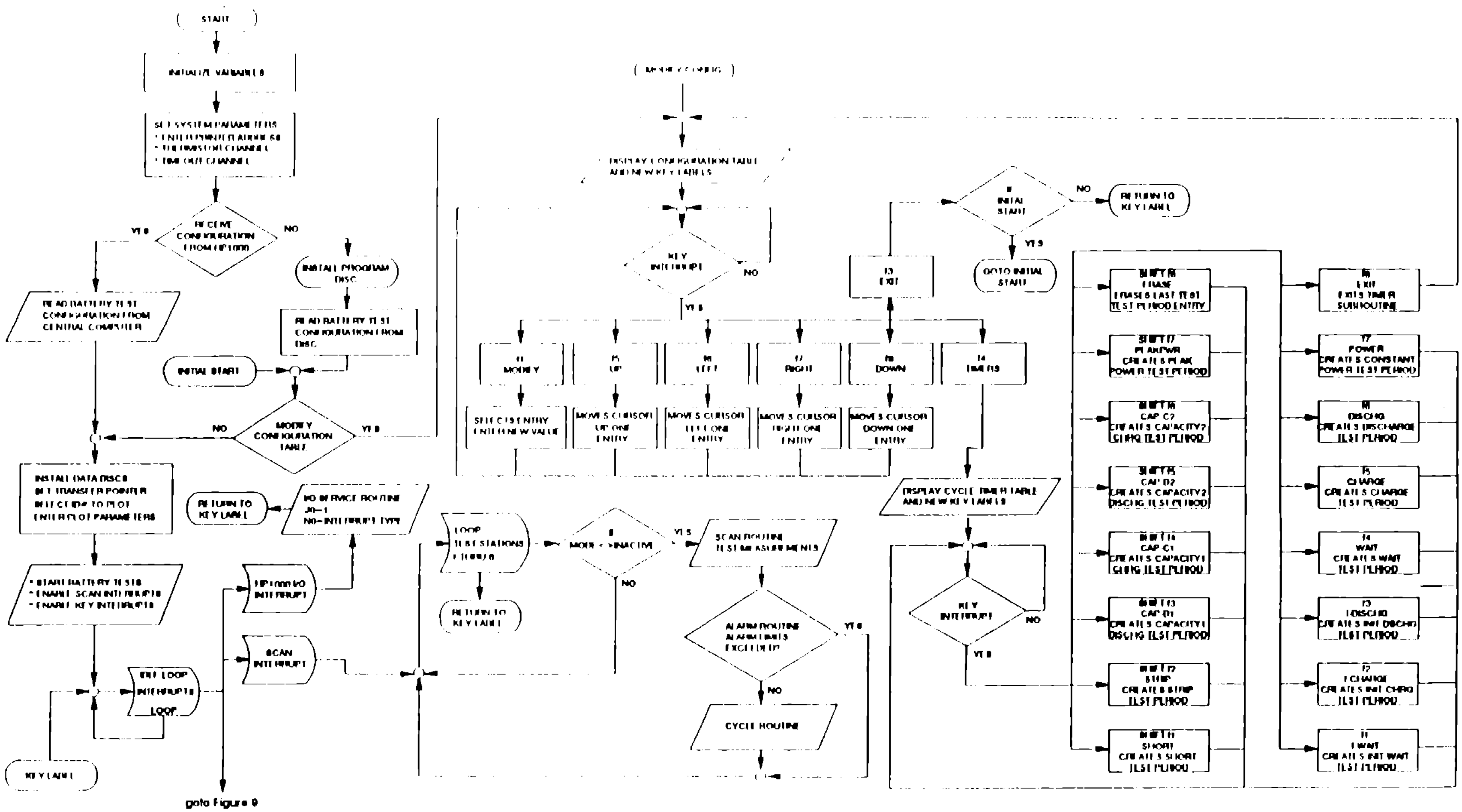


Figure 8. Flowchart of NEWBT Program

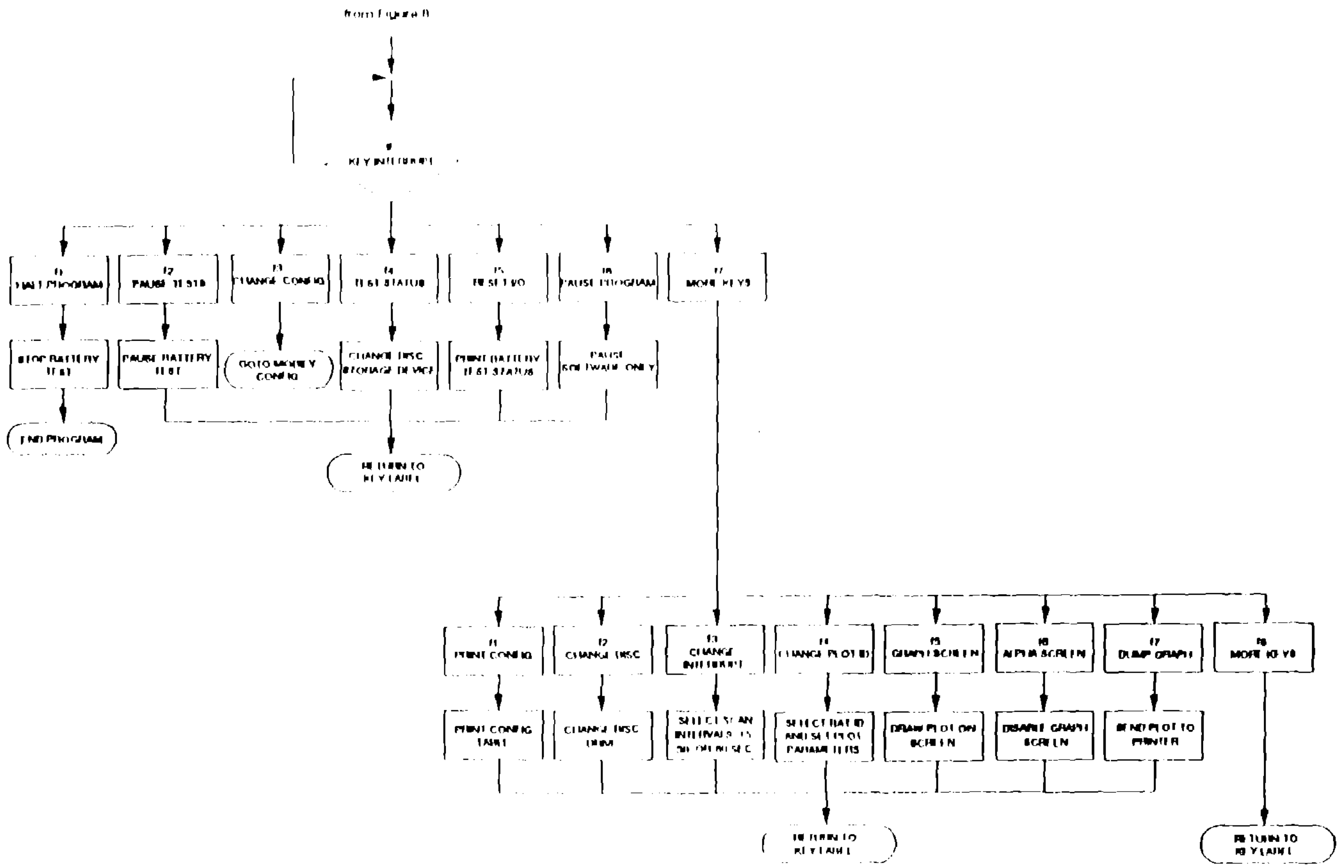


Figure 9. Flowchart of NEWBT Program (continued)

groups of operational procedures. The following briefly discusses each of the three groups.

The first software group contains subroutines that initialize array variables and allow users to modify entries in the Battery Test Configuration Table to create test cycles. When the software is first executed, it initializes all numeric arrays; this takes approximately a minute. After the initialization of program variables, the operator is asked to set up some system parameters such as LU printer address, thermistor channel, and timeout channel. The operator then configures all battery tests such as set battery ID#, scanner channels, alarms limits, start test mode, number of cycles, etc. Once this has been completed, all battery tests are started. Changes to the Battery Test Configuration Table or the Cycle Test Timer Table can also be made after the testing process has started.

The second software group contains subroutines that perform the actual battery testing process. This is accomplished by checking the TEST MODE entry in the Battery Test Configuration Table for an entry not equal to INACTIVE for each of the six test stations. If this is true, then the battery test will follow that which was created in the Cycle Test Timer Table. One cycle is equal to one complete rotation through the Cycle Test Timer Table test period entries.

When a cycle is completed the NUMBER OF CYCLES entry in the Battery Test Configuration Table is reduced by one. When NUMBER OF CYCLES equals zero, the battery is placed in a MONITOR test mode. In the MONITOR test mode, test measurements are made with the battery in an open circuit state.

The third software group contains subroutines that perform the I/O communication with the central computer system (HP1000). This software includes subroutines that allow the Battery Test Configuration Table and the Cycle Test Timer Table to be received from the central computer system; subroutines that output the test status of each battery to the central computer; subroutines that transfer battery test data records from the mass storage device to the central computer system; and subroutines that transfer graph data to the central computer system for the generation of real-time plots.

3.1.5 Test Measurements

Test measurements are performed on every battery not in an INACTIVE test mode. Measurements are made once a minute and at the start and end of each test period. This is performed in the SCAN subroutine. Within the SCAN subroutine software, test limits are also checked.

Once battery testing begins, a 1 minute interrupt is enabled. This interrupt is directed to the TIMER_SERVICE subroutine. The TIMER_SERVICE subroutine checks the test mode of each battery in the system for test modes not equal to INACTIVE. If this is true, the SCAN subroutine is executed. At the completion of the SCAN subroutine, the CYCLE subroutine is executed for all test modes not equal to MONITOR. Within the CYCLE subroutine, test period cutoff parameters for each active test are checked. If a test period is completed, a pointer, CYCLE variable, which keeps track of test period execution, is incremented by one. The CYCLE variable now points to the next test period within the Cycle Test Timer Table. If this is the last test period of a cycle, the NUMBER OF CYCLES variable within the Battery Test Configuration Table will be reduced by one, the CYCLE pointer will be set to the first test period of the cycle, and the test period will be started. These operations take place for each battery contained in the LU.

3.1.6 Test Flag Definitions

As described in Section 3.1.3, battery test flags are stored as the fractional part of the first element in a data record. Test flags are used to identify battery test periods when analyzing test data. All battery test periods have a particular test flag assigned to them. Table 5 lists all test flags and defines the test period assigned to them.

3.1.7 NEWBT Operating Procedures

3.1.7.1 Installing and Running Software

The NEWBT software program, the Battery Test Configuration Table, and the Cycle Test Timer Test Table are contained on a single 3.5" disc. Before the NEWBT software program can be installed, the BASIC 5.1 operating system must be running. Perform Procedure 1 to install the operating system.

Procedure 1. Installing BASIC 5.1 Operating System

(1) The HP9000 Series 310 computer must be in the off state.

(2) Install the BOOT SYSTEM DISC into the left drive of the HP9122 disc drive unit.

(3) Switch on power to the computer. This automatically installs the BASIC 5.1 Operating System. The installation is complete when the copyright information is displayed on the screen.

The NEWBT battery test software can now be installed into the HP9000 Series 310 computer. This can be accomplished by performing Procedure 2.

Table 5. Test Flag Assignments

Flag	Description	Test Period
.00	Start of Cycle Test	All test periods except INACTIVE, MONITOR, and PEAKPWR
.01	Start of Initial Discharge Period	INIT DSCHG
.02	Initial Discharge	INIT DSCHG
.03	End of Initial Discharge Period	INIT DSCHG
.04	Start Wait Period	INIT WAIT, WAIT, STRIP
.05	Wait Period	INIT WAIT, WAIT, STRIP
.06	End of Wait Period	INIT WAIT, WAIT, STRIP
.07	Start of Discharge Period	DISCHARGE, POWER
.08	Discharge Period	DISCHARGE, POWER
.09	End of Discharge Period with more cycles forthcoming	DISCHARGE, POWER
.10	Start of Charge Period	CHARGE
.11	Charge Period	CHARGE
.12	End of Charge Period with more cycles forthcoming	CHARGE
.13	End of Charge Period and End of Test	CHARGE
.14	End of Discharge Period and End of Test	DISCHARGE, POWER
.40	Start of Peak Power Test	PEAKPWR
.41	Current at 66.7% of OCV	PEAKPWR
.42	OCV before Peak Power Test	PEAKPWR
.43	Start of 30 second Peak Power Test	PEAKPWR
.44	Peak Power Test Discharge	PEAKPWR
.45	End of Peak Power Discharge	PEAKPWR
.46	End of Peak Power Test	PEAKPWR
.60	Battery in Open Circuit State	MONITOR
.96	Low Alarm value reached	
.97	High Alarm value reached	

Procedure 2. Installing NEWBT Software

(1) The BASIC 5.1 operating system must have been previously installed; if not, perform Procedure 1.

(2) Install the NEWBT program disc into the left drive of the HP9122 disc drive unit.

(3) Enter the following command: LOAD "NEWBT:,700,0"

The NEWBT software program is very large and takes a minute or so to load. After the software is loaded, it can be executed. Procedure 3 describes all the steps required to execute and configure NEWBT system parameters.

Procedure 3. Setting NEWBT System Parameters

(1) To execute the NEWBT program press the RUN key (f3). The following message will be displayed: **"Please Wait."** At this point NEWBT initializes all program variables.

(2) The following question is asked:

Please enter printer select code and address?

All LUs have the printer's select code and address set to 1001. Answer this question by entering 1001.

(3) The following question is asked:

The present system thermistor channel is 79. Do you wish to change this (Y or N)?

The following are the thermistor channel assignments for each LU.

LU 23 = 79	LU 27 = 119
LU 24 = 79	LU 28 = 79
LU 25 = 79	LU 29 = 119
LU 26 = 79	LU 30 = 79

If running NEWBT on an LU with a thermistor channel that differs from the default setting, answer Y to this question, else answer N.

If you answered Y, the following question is asked:

Enter a new thermistor channel number:

Answer this question by entering the new thermistor channel number.

(4) The following question is asked:

The present system time out channel is 4. Do you wish to change this (Y or N)?

The following are the system time out channel assignments for each LU.

LU 23 = 4	LU 27 = 4
LU 24 = 4	LU 28 = 4
LU 25 = 4	LU 29 = 119
LU 26 = 4	LU 30 = 4

If you are running NEWBT on a LU with a system time-out channel that differs from the default setting answer Y to this question, else answer N.

If you answered Y, the following question is asked:

Enter a new system channel number:

Answer this question by entering a new system time-out channel number.

(5) The following question is asked:

Is this computer being used to test batteries on high temperature stations?

The following LUs are configured with high temperature test stations; 25, 27, and 28. If you are running NEWBT on any of these LU, answer Y to this question. If you answered Y the following question will be asked:

Enter high temperature alarm output channel (slot#, relay channel):

The following are the high temperature alarm channel assignments for the LUs that are configured with this option.

LU 25 = slot# 14, relay channel 15
LU 27 = slot# 4, relay channel 13
LU 28 = slot# 14, relay channel 15

Enter the slot# and relay channel assignment for the high temperature alarm output that corresponds to the LU presently running NEWBT. Next you are asked the following.

Enter low temperature alarm output channel (slot#, relay channel):

The following are the low temperature alarm channel assignments for the LUs that are configured with this option.

LU 25 = slot# 14, relay channel 14
LU 27 = slot# 4, relay channel 12
LU 28 = slot# 14, relay channel 14

Enter the slot# and relay channel assignment for the low temperature alarm output that corresponds to the LU presently running NEWBT.

You have now completed the initial system setup. It is now time to configure the Battery Test Configuration Table and the Cycle Timer Table. These tables reside in both the central computer system and on the NEWBT program disc. Procedure 4 describes how to receive this information from the central computer system. Procedure 5 describes how to read this information from the NEWBT program disc.

Procedure 4. Receiving the Test Configuration Table from Central Computer

(1) The following question is asked:

Will you be receiving Battery Test Configuration Table from central computer?

Answer Y to this question. You will now notice the message "I/O WAIT" blinking on the screen. This means NEWBT is waiting for this information to come from the central computer. The transfer is initiated at the central computer side. This operation is discussed in Section 3.2.4, Procedure 5, Downloading Battery Test Configuration Table.

As the Battery Test Configuration Table is being received, the following message is displayed:

Received configuration block for ID # XXX

Proceed to Procedure 9.

Procedure 5. Reading Test Configuration Table from NEWBT Program Disc

(1) The following question is asked:

Will you be receiving Battery Test Configuration Table from central computer?

Answer N to this question.

(2) The following is now prompted:

Install program disc into disc drive 0 and press CONTINUE key!

Insert the NEWBT program disc into the left drive of the HP9122 Disc Drive unit and press the CONTINUE key (f2). The following message is displayed:

Reading configuration array (PLEASE WAIT)

(3) After the Battery Test Configuration Table has been read from disc, the following question is asked:

Would you like to modify the configuration array (Y or N)?

If you answered N to this question, proceed to Procedure 9. By answering Y to this question, a listing of all battery identification numbers, manufacturers, Amp-hour ratings, and test modes for each battery presently contained in the Battery Test Configuration Table are displayed.

(4) The following is prompted:

Enter ID# of battery you wish to modify:

Enter one of the battery ID#s listed.

Procedure 6. Modifying Battery Test Configuration Table Entries

The Battery Test Configuration Table for the ID# entered is now displayed on the screen. First, note that the entry under the BATT ID# heading is underlined. The underline indicates entries that can be modified. Second, note the special function key list. To make changes to an entry, change the underscore cursor location, modify the Cycle Time Timer Table, or exit from this screen, you must use the special function keys f1 through f8. The keys are defined as follows.

f1 = "MODIFY"	Enables entry presently underlined to be modified.
f2 = " "	Not used.
f3 = "EXIT"	Allows you to exit from this screen.
f4 = "TIMERS"	Changes screen to the Cycle Timer Table where test periods are created.
f5 = "UP"	Moves the underscore up one entry.
f6 = "LEFT"	Moves the underscore to the left one entry.
f7 = "RIGHT"	Moves the underscore to the right one entry.
f8 = "DOWN"	Moves the underscore down one entry.

If you press f1 to change the underlined entry, that entry will be highlighted. Then simply type in your new value. Note that there is a 15 character limit per entry.

If you change the BATT ID# entry, note that you must enter a battery identification number (4 digits maximum). Also, indicate whether the test station this battery is connected to, is RELAY or D/A controlled. All test stations on all LUs can be controlled either way. Please note that the RELAY or D/A designation must begin on the 6th character position of the BATT ID# entry.

By selecting the f3 key, the Cycle Timer Table is displayed. Procedure 7 discusses how to create, modify, and delete test periods within this table.

After selecting the EXIT key (f3) go to Procedure 9.

Procedure 7. Creating, Modifying, and Deleting, Test Periods within the Cycle Timer Table

The Cycle Timer Table contains test periods (modes) that form a battery test. Notice the screen contains test period entries that lie under the "Present Test Cycle Config" and "New Test Cycle Config" headings. The present contents of the Cycle Timer Table lie under the "Present Test Cycle Config" heading. When new test periods are generated, they appear under the "New Test Cycle Config" heading.

Note the heading "Use special function keys to create your test cycle." Use SHIFT+function keys for lowercase test modes. Each test period is assigned a special function key. The following lists these assignments.

f1 = "I-WAIT"	Initial Wait Period
f2 = "I-CHARGE"	Initial Charge Period entry
f3 = "I-DISCHG"	Initial Discharge Period entry
f4 = "WAIT"	Wait Period entry

f5 = "CHARGE"	Charge Period entry
f6 = "DISCHG"	Discharge Period entry
f7 = "POWER"	Constant Power Discharge Period entry
f8 = "EXIT"	Return to Battery Test Configuration Table
shift f1 = "SHORT"	Shortout Period entry
shift f2 = "STRIP"	Strip Period entry
shift f7 = "PEAKPWR"	Peakpwr Test entry
shift f8 = "ERASE"	Erase last test period entry.

The following describes how to create test periods using the special function keys. Note that answers in "" are entered as shown; items in [ ] are optional parameters.

Key f1 "I-WAIT"

By selecting the f1 key, an INITIAL WAIT test period entry is created. The following question is asked:

Enter INITIAL WAIT period cutoff parameter (time).

Enter the number of minutes the wait period is to last. This test period will be performed once during a cycle set. During a wait period, the battery is placed in an open circuit state.

Key f2 "I-CHARGE"

By selecting the f2 key, an INITIAL CHARGE test period is created. The following question is asked:

Enter INITIAL CHARGE period cutoff parameters (time"-"[volts"V"]ahr over-chg"%"]amps)

Enter the maximum number of minutes this period can last followed by a "-." Then, enter an optional voltage cutoff value followed by a "V" or an optional Amp-hour overcharge percentage followed by "%." The Amp-hour overcharge percentage is based on the capacity rating of the battery. This value is contained in the Battery Test Configuration Table.

If this test station is D/A controlled, then end this entry by stating a charge current level. This test period will be performed once during a cycle set.

Key f3 "I-DISCHG"

By selecting the f3 key, an INITIAL DISCHARGE test period is created. The following question is asked:

Enter INITIAL DISCHARGE period cutoff parameters (time"-"[volts"V"]DOD"%"]amps)

Enter the maximum number of minutes this period can last followed with "-." Then, enter an optional voltage cutoff value followed by a "V" or an optional depth-of-discharge (DOD) percentage followed by "%." The depth-of-discharge percentage is based on the capacity rating of the battery. This value is contained in the Battery Test Configuration Table.

If this test station is D/A controlled, then end this entry by stating a discharge current level. This test period will be performed once during a cycle set.

Key f4 "WAIT"

By selecting the f4 key, a WAIT test period entry is created. The following question is asked:

Enter WAIT period cutoff parameter (time).

Enter the number of minutes the wait period is to last.

Key f5 "CHARGE"

By selecting the f5 key, a CHARGE test period is created. The following question is asked:

Enter CHARGE period cutoff parameters (time"-"[[volts"V"]ahr overchg"%"]amps)

Enter the maximum number of minutes this period can last followed by "-." Then, enter an optional voltage cutoff value followed by a "V" or an optional amp-hour overcharge percentage followed by "%." Amp-hour overcharge percentage is based on the capacity rating of the battery. This value is contained in the Battery Test Configuration Table.

If this test station is D/A controlled, then end this entry by stating a charge current level.

Key f6 "DISCHARGE"

By selecting the f6 key, a DISCHARGE test period is created. The following question is asked:

Enter DISCHARGE period cutoff parameters (time"-"[[volts"V"]DOD"%"][hi"/"low]amps)

Enter the maximum number of minutes this period can last followed by "-." Then, enter an optional voltage cutoff value followed by "V" or an optional depth-of-discharge percentage followed by "%." The depth-of-discharge percentage is based on the capacity rating of the battery. This value is contained in the Battery Test Configuration Table.

If this test station is D/A controlled, then end this entry by stating a discharge current level in one of two ways. The first is a pulse discharge. Enter a high and low current levels. Note that pulsed discharging is used to calculate battery resistance. The second is a constant current discharge. This is done by simply entering a current level.

Key f7 "POWER"

By selecting the f7 key, a CONSTANT POWER test period is created. The following question is asked:

Enter CONSTANT POWER discharge period cutoff parameters (time"-"[volts"V"]watts)

Enter the maximum number of minutes this period can last followed by a "-." Then, enter an optional voltage cutoff value followed by a "V." If this test station is D/A controlled, then end this entry by stating a wattage level.

Shift f1 "SHORT"

By selecting the Shift f7 key, a SHORTOUT test period is created. The following question is asked:

Enter SHORTOUT period relay channel and initial current level (ch#"-"amps)

Enter the SHORTOUT relay channel number for this test station. If this test station is D/A controlled, then enter a "-" followed by an initial shorting current level.

Shift f2 "STRIP"

By selecting the Shift f8 key, a STRIP test period is created. The following question is asked:

Enter STRIP period parameters (time"-"channel#)

Enter the number of minutes this period is to last followed by a "-." Then, enter the strip relay channel for this test station.

Shift f7 "PEAKPWR"

By selecting the Shift f8 key, a PEAK POWER test period is created. The following question is asked:

Enter PEAKPWR period parameters (initial DOD"%-"ocv"%")

Enter the percent depth-of-discharge of the battery where the test will be executed. Follow this with a "%-." Then, enter the percentage of the battery's open circuit voltage at which the test will be performed. This value is normally 50% or 66.7%. Follow this with a "%."

Procedure 8. Continuing with NEWBT Initial Test Setup

(1) The following question is asked:

Would you like to modify the configuration table (Y or N)?

If you entered Y, go to Step 4 of Procedure 5.

(2) The screen now lists the battery test header options that are available within NEWBT. The following question is asked:

Enter the number of the header you wish to use for this test (1, 2, or 3)?

Once you have chosen your header, NEWBT displays a "PLEASE WAIT" message for about 10 seconds while NEWBT converts the Battery Test Configuration table to numeric arrays.

(3) The following question is now asked:

Would you like to read the AMPHR & WATTHR data files (Y or N)?

The AMPHR & WATTHR data files are used by the system administrator when he is continuing battery tests after making software changes to NEWBT. This question should almost always be answered N.

(4) The screen now displays the following message:

Put all select switches in the REMOTE position. Install a battery data disc into drive 0 of the HP9122 disc drive unit. Press the CONTINUE key (f2) when this is completed.

Normally two data discs are used: one in drive 0 and the other in drive 1 of the HP9122 disc drive unit. Insert these discs and press f2 key.

(5) The screen now lists each ID#, Manufacturer, Capacity Rating, and Start Test Mode for each battery contained within the Battery Test Configuration Table. Also displayed are the values for the L and N pointers from the POINT file on the data disc. This screen is automatically cleared in three seconds. The following question is then asked:

Start data transfer record pointer is XX
Do you wish to change this (Y or N)?

The transfer pointer is used during data transfers between the central computer and the LUs. The data transfer pointer, referred to as PNTR, is equal to the last data disc record that was previously transferred. When starting

NEWBT this value should be set to what it was when the program was last stopped.

Note that the value for the data transfer pointer displayed on the screen is equal to the L pointer. This is more than likely wrong, so by answering N to this question the following question will be asked:

Enter a new record number where data transfers will begin:

Enter the new value to the data transfer pointer (PNTR).

(6) The screen now lists each ID#, Manufacturer, Capacity rating, and Start Test Mode for all batteries contained within the Battery Test Configuration Table. The following question is asked:

Enter the ID# of the battery you wish plotted:

Choose a battery from the list displayed on the screen.

(7) The screen now lists the available data items that can be plotted. NEWBT plots two data items on one screen. The following question is asked:

Enter code number of the variable you wish to plot on graph A:

Code numbers for each data item are listed to the left of the data item. Enter a code number.

(8) Now the following question is asked :

Now enter scaling parameters for this data item (max, min, div):

Enter the maximum and minimum value you expect this variable to reach. The div value is normally the maximum value divided by the minimum value. Note, each value must be separated by commas.

(9) The following question is asked:

Enter code number of the variable you wish to plot on graph B:

Code numbers for each data item are listed to the left of the data item; enter a code number.

(10) Now the following question is asked:

Now enter scaling parameters for this data item (max, min, div):

Enter the maximum and minimum value you expect this variable to reach. The div value is normally the maximum value divided by the minimum value. Note, each value must be separated by commas.

Procedure 9. Battery Test Key Assignments

You have now completed the initial setup of NEWBT program. At this point, NEWBT takes over. It scans the Battery Test Configuration Table for active test modes. Tests are started based on each battery's test mode.

After all active battery tests are started, a one minute interrupt is enabled which performs test measurements and checks test period cutoff parameters. This interrupt is enabled in the SET_INTERRUPT subroutine. In this subroutine the special function keys get assigned. There are two groups of key assignments, primary and secondary. The primary key group contains key assignments that affect the battery testing process, while the secondary key assignments are used mainly to provide services.

The following is a list of the primary key assignments.

f1 = "Halt Program"	Ends Battery testing and stops NEWBT execution.
f2 = "Pause Program"	Pauses battery tests and NEWBT execution.
f3 = "Change Config"	Allows changes to be made to the Battery Test Configuration Table and Cycle Timer Table. See Procedure 7.
f4 = "Test Status"	Prints a brief test status summary on each battery under test.
f5= "Reset I/O"	Resets I/O pointers N0 and J0, enables I/O interrupts from central computer.
f7 = "More Keys"	Displays secondary key assignments.
f8 = "Pause Software"	Suspends execution of NEWBT, battery tests remain active.

The following is a list of the secondary key assignments.

f1 = "Print Config"	Prints the contents of the Battery Test Configuration Table on the system printer.
f2 = "Change Disc"	Changes the default mass storage device. If the default

	device is drive 0, then it is changed to drive 1, or if it is drive 1, then it is changed to drive 0.
f4 = "Change Plot Idn"	Provides a means to change plot parameters. See Procedure 9, Steps 6 through 10.
f5 = "Graph Screen"	Enables graphics screen, displays graph chosen in Procedure 9.
f6 = "Alpha screen"	Disables graphics screen, changes to default screen.
f7 = "Dump Graph"	Copies the graphics screen to the system printer.
f8 = "More Keys"	Displays the primary key assignments.

Procedure 10. When Software Errors Occur

Most software errors are user generated. When a software error is detected, NEWBT suspends all battery tests, displays the error message, and pauses. At this point, the system administrator should be contacted. If this is not possible, perform the following.

(1) Look up error code in BASIC 5.1 Reference manual.

(2) If the error code pertains to a variable, the variable can be changed to correct the error. To do this, simply find the line where the error was created. This can be found from a listing of NEWBT program or by typing EDIT XXXX, where XXXX is the line number that created the error. Find the variable that created the error and change its value. Once this is done, press the CONTINUE key (f2). NEWBT should start all tests and continue normally.

(3) If the error was generated in one of the I/O subroutines, it is very difficult to recover from. Try the following:

a. Type in PAUS=1 and press CONTINUE key (f2).

b. When NEWBT suspends (this will be known when a underscore appears at the lower right-hand corner of the screen) type in CONTINUE 1615.

c. When key label assignments appear on screen, press the STOP key (located in the upper left-hand corner of the keyboard).

d. Type in CONTINUE 1895. If the same error message appears on the screen, type in CONTINUE 1895 again.

e. When the secondary key assignment appears on the screen you have recovered from the error.

f. Next, press f8 key ("More Keys") then press f8 key ("Pause Software"). Now press the CONTINUE key (f2), this resets all interrupts.

g. Done

(4) If the error code is 3 or 121, or if the other recovery methods do not work, perform the following.

a. Stop the program by pressing the STOP key.

b. Remove the data disc from the default disc drive and insert the program disc.

c. Type in PNTR and hit return key. This value is the I/O data transfer pointer; write it down.

d. Type in ASSIGN @AHR to "AH_ARRAY"&MSDS

e. Type in OUTPUT @AHR;AH(*)

f. Type in ASSIGN @AHR to *

g. Type in ASSIGN @WATT to "WH_ARRAY"&MSDS

h. Type in OUTPUT @WATT;WH(*)

i. Type in ASSIGN @WATT TO *

j. Type in ASSIGN @DATA to "CDATA"&MSDS

k. Type in OUTPUT @CDATA; CDATAxx(*) note: xx is equal to the Line Unit number.

l. Type in ASSIGN @CDATA TO *

m. Press the LOCAL key then the RESET key on the line unit's HP3497A data acquisition/control unit.

n. Make software changes at this point.

o. Run NEWBT from scratch, see Procedures 3 through 9. On Procedure 4, Step 1 answer N; you want to read Battery Test Configuration Table from the program disc. On Procedure 5, Step 3 answer N;

you do not want to change Configuration Table. On Procedure 9, Step 3 answer Y; you do want to read the AMPHR and WATTHR data files. On Procedure 8, Step 5, answer Y; enter the data transfer pointer value you have written down.

p. All battery tests should now be at the same point they where when the error occurred.

3.2 CONFIG Software Program

CONFIG is a software program that resides in the central computer. This program is mainly used to remotely configure battery tests, but it also provides data transfers from LUs, battery test status information, LU system information, and real-time data plots; it also shows a block diagram of the test facility. The CONFIG program is made up of four programs: the father program, CONFIG, and the son programs, IOPROG, PLTR48, and UPDATE. Figures 10, 11, and 12 show simplified flowcharts of the CONFIG program and its slave programs IOPROG, PLTR48, and UPDATE. All programs are written in FORTRAN 77. Like the NEWBT program, the heart of the CONFIG program is within the CONFG.DAT and BRIEF.DAT data files.

3.2.1 CONFG.DAT Data File

The CONFG.DAT table contains the test configurations for all batteries under test within the Battery Test Facility. CONFG.DAT is similar to the Battery Test Configuration Table in the NEWBT program. The only difference is two additional entries for data pointers to the BRIEF.DAT data file. See Section 3.1.1 for a complete discussion on the contents of the CONFIG.DAT data file. Each battery's Cycle Timer Table is also contained within the CONFG.DAT file. For a complete discussion on the contents of the Cycle Timer Table, see Section 3.1.2.

3.2.2 BRIEF.DAT Data File

The BRIEF.DAT file contains pointers and I/O Line Unit addresses for each battery contained within the Battery Test Facility. The BRIEF.DAT data file is set up to handle up to 50 battery assignments. Table 6 lists an example of the contents of the BRIEF.DAT data file. The CONFG.DAT position entries point to a row location within the CONFG.DAT file where this battery's test configuration is located. Configuration Table position entries point to a row location within an LUs Battery Test Configuration Table where this battery's test configuration is located.

3.2.3 Functions of CONFIG Program

The purpose of the CONFIG program is to provide a means by which all battery tests can be configured and started from a central location. Configuring tests is accomplished through the MODFY subroutine and IOPROG son program. An operator selects the battery to be modified, configures a test, then downloads the test configuration to the LU. The test then begins. CONFIG also provides data transfers, battery test status information, LU system information, and real-time data plots and shows a block diagram of the test facility.

Data transfers occur between a selected LU and the CONFIG program. When a user selects a data transfer operation, CONFIG schedules the UPDATE program to perform this task. The UPDATE program interrupts the NEWBT program at the selected LU and requests this operation. After the next data measurements are made by NEWBT, data records are sent starting at the PNTR data transfer pointer and ending at the value of the L pointer.

The data is received by the UPDATE program, which, in turn, saves it in a data file called RTEMP.DAT.

At the completion of the data transfer, a message is printed showing the number of records transferred and the start and end record number in RTEMP where the data resides.

Battery test status information can be obtained from each LU within the test facility. This is accomplished through the STATUS feature of the CONFIG program. This operation is used to update the Battery Test Configuration Table within the CONFIG program. This operation also generates a listing of the present battery test status of each battery contained within the selected LU. The operation is accomplished through the IOPROG son program. An operator selects an LU, and after about a minute, the test status information is printed and the configuration table updated.

LU system information can be obtained for each LU within the Battery Test Facility. This is accomplished through the INQUIRE feature. The INQUIRE operation generates a listing of the present system parameters of a select LU. The listing includes: LU number, present value of the PNTR pointer, number of data records presently stored on disc, maximum data records possible on the present storage device, and current mass storage device.

Real-time graphs of battery voltage and current versus time can also be accomplished by the CONFIG program through the PLOT feature. The operator selects a battery to be plotted and the graph is generated on the terminal. The operator has several options from which to select to manipulate the graph. The graph plots the data for the last 24 hours for the selected battery.

A simplified block diagram of the test facility can be obtained by the CONFIG program through the DISPLAY SYSTEM feature. The diagram is generated on the terminal, and, if the operator wishes, it can be printed.

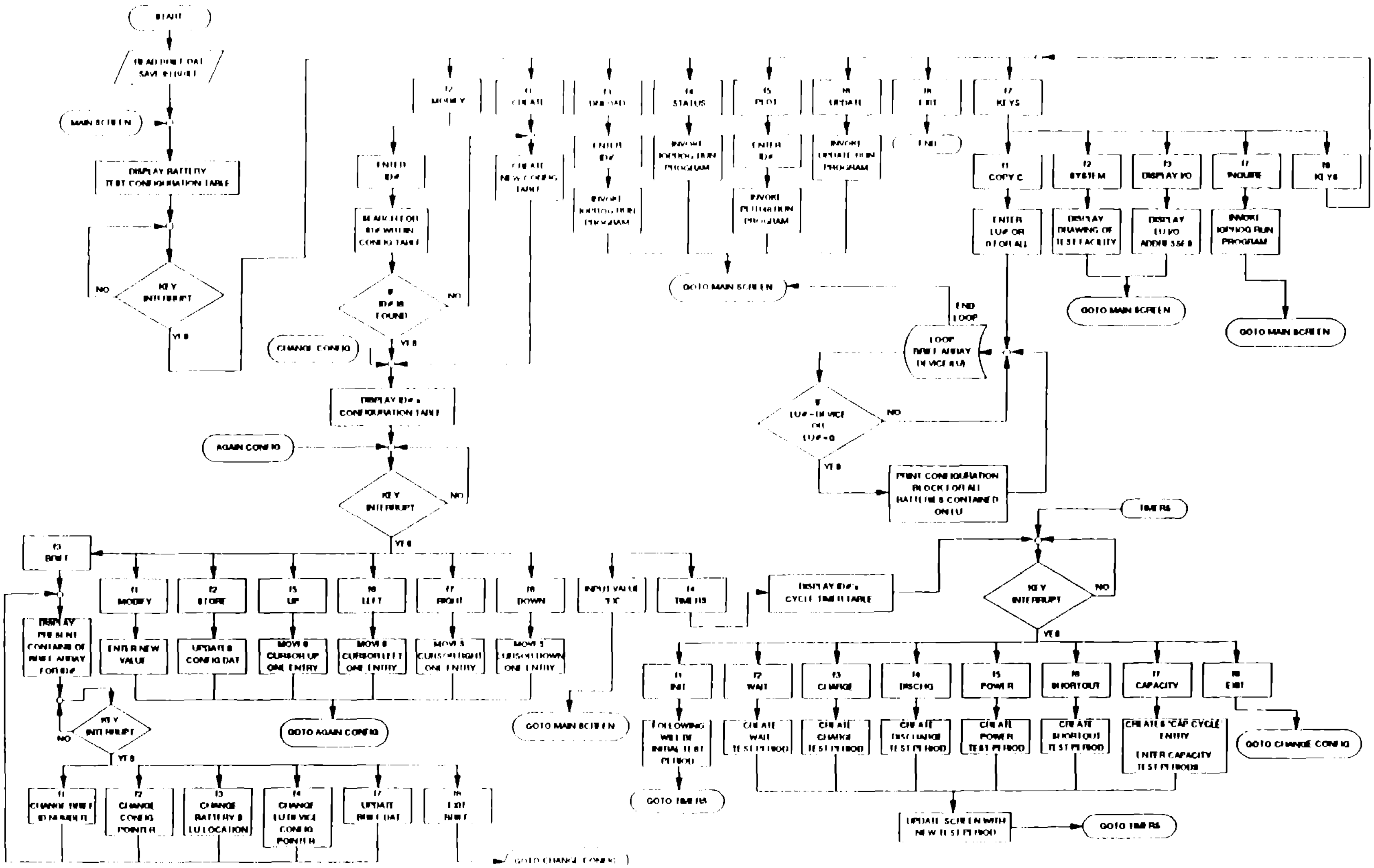


Figure 10. Flowchart of CONFIG Program

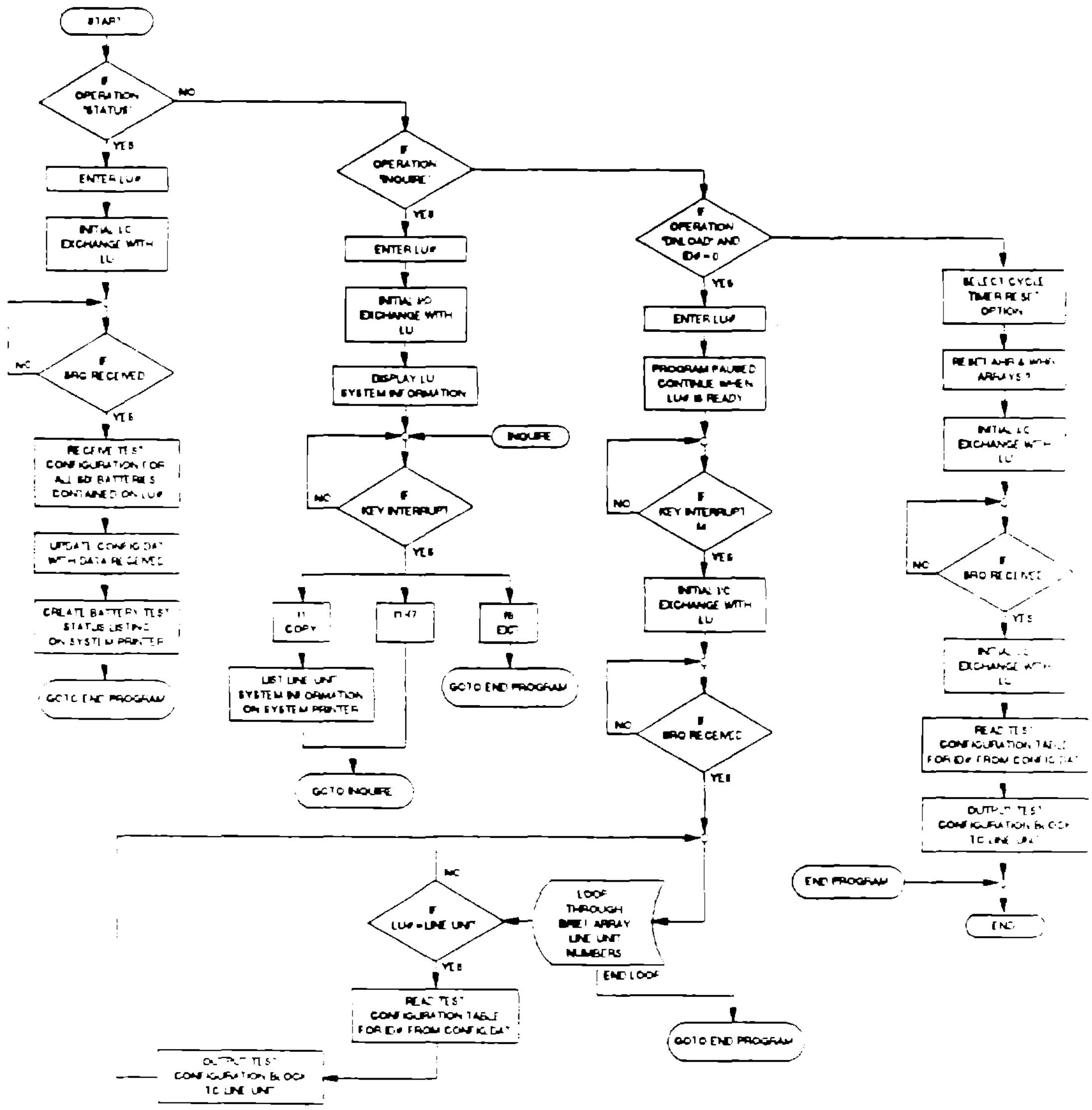


Figure 11. Flowchart of IOPROG Program (Note: the program is invoked by CONFIG program, see previous page)

3.2.4 CONFIG Operating Procedures

3.2.4.1 Executing CONFIG Program

The CONFIG program is located in the /OPERATIONS directory. To run this program, execute the command CONFIG at the CI prompt. The screen will display a listing of all batteries and their associated LUs contained within the Battery Test Facility. The display should look similar to that shown in Figure 13.

Notice each LU contains six test stations. Under each test station heading it lists battery identification numbers and test modes for every battery in the system. This listing may differ from what is actually contained on the LUs themselves. If this is the case, a STATUS operation can be executed to update this listing. This will be discussed later in this document. Notice that each battery's test mode title is shortened so that all batteries may be contained on a single screen.

This screen is referred to as CONFIG's main menu display. Through this screen all of CONFIG's functions are initiated. Functions are executed through special key assignments listed along the bottom of the screen. The key assignments are as follows:

f1 = "Create"	Used to generate a new test station entry in the Test Configuration Table.
f2 = "Modify"	Enables operator to make changes to a battery's test configuration.

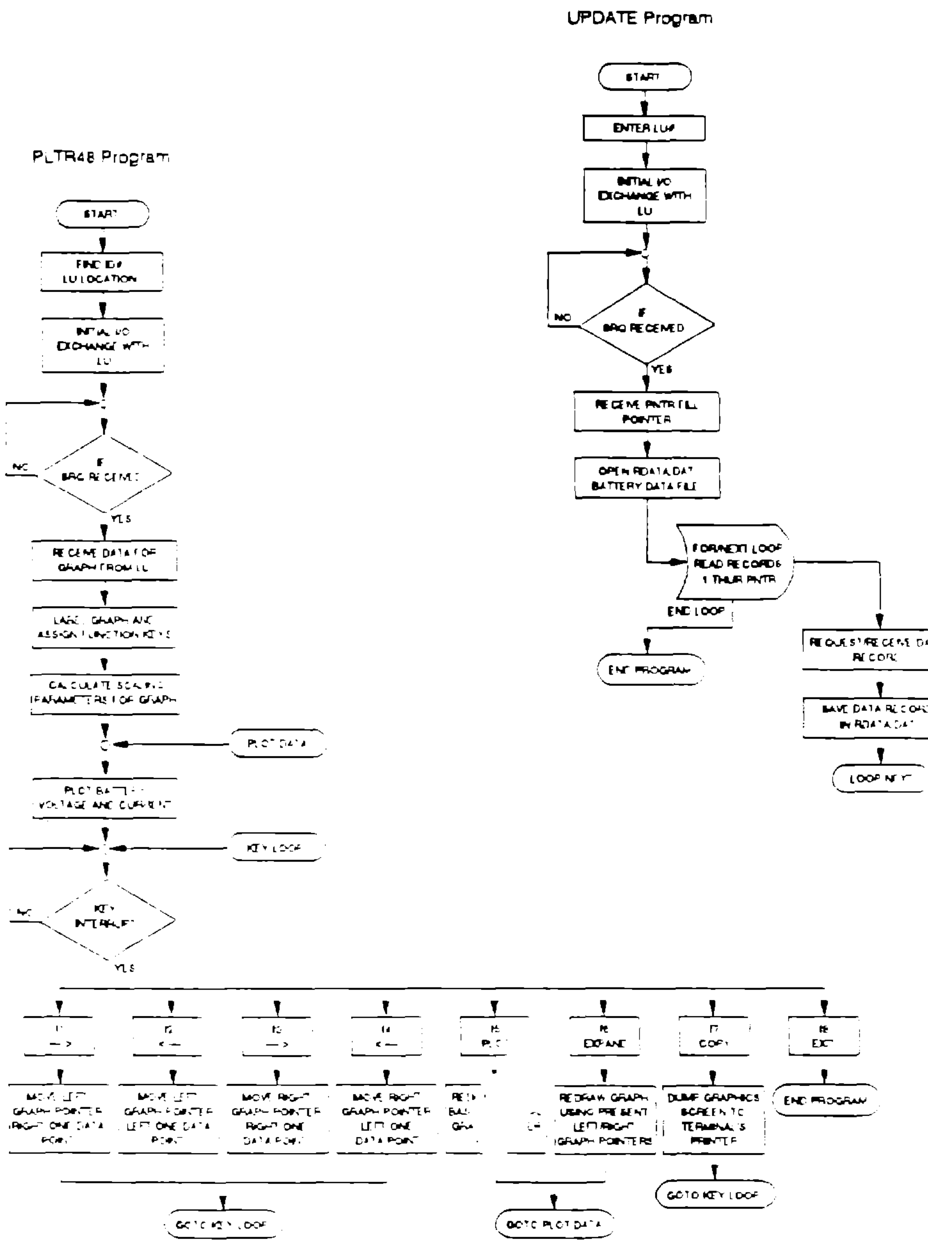


Figure 12. Flowchart of PLTR48 and UPDATE Programs (Note: this program is invoked by CONFIG program, see previous page)

f3 = "Dnload"	Transfers a block of the Test Configuration Table for a battery or full LU to its associated LU.
f4 = "Status"	Updates the Test Configuration Table with information received from the LUs.
f5 = "Plot"	Generates a graph of the last 24 hours of test information for a selected battery.
f6 = "Update"	Performs a data transfer from a selected LU into CONFIG's RDATA.DAT file.
f7 = "Keys"	Displays CONFIG's secondary key assignments.

Test System Configuration Table

Test Controllers

	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6
LU23 :	200/MONTR	935/INACT	357/INACT	395/INACT	396/INACT	503/WAIT3
LU24 :	4/INACT	71/INACT	451/INACT	450/INACT	199/INACT	497/CHRG1
LU25 :	500/INACT	501/DSCH1	300/MONTR	515/INACT	489/INACT	477/INACT
LU26 :	1/MONTR	2/MONTR	3/INACT	4/MONTR	5/MONTR	6/INACT
LU27 :	512/WAIT1	507/WAIT1	508/WAIT1	509/CHRG1	510/WAIT1	511/WAIT2
LU28 :	469/INACT	470/INACT	471/MONTR	506/WAIT1	299/INACT	474/INACT
LU29 :	442/INACT	402/INACT	428/INACT	444/INACT	504/INACT	514/DSCH1

CREATE	MODIFY	DNLOAD	STATUS	PLOT	UPDATE	KEYS	EXIT

Figure 13. CONFIG's Main Screen Menu

f8 = "Exit" — Ends CONFIG program.

The following is a list of CONFIG's secondary key assignments:

f1 = "Copy C" — Prints the contents of the Test Configuration Table on the system printer.

f2 = "System" — Displays a simplified diagram of Battery Test Facility layout.

f3 = "Dip IO" — Displays a screen that lists each battery's ID#, Room#, LU, Address, Device Address, and Brief array position.

f4, f5, f6 = not assigned

f7 = "Inquire" — Reads system information from selected LUs.

The following are operational procedures for each of the special function key assignments:

Procedure 1. Creating New Test Configuration Table Entries (Create)

This function is not presently available.

Procedure 2. Modifying Test Configuration Table (Modify)

The Modify operation is used to change entries in the Test Configuration Table. To initiate this process, press the MODIFY key (f2). The following question is asked:

Enter ID # of the battery unit to be modified:

Answer this by entering the identification number of the battery to be modified. The number you enter must be listed in the Test System Configuration Table.

The screen now displays the present contents of the configuration array for this battery. The screen looks similar to that shown in Figure 14. Associated with this screen are special function key assignments listed in Figure 14.

f1 = "Modify" — Enable a change to the entry presently highlighted.

f2 = "Store" — Updates the Test Configuration Table with the entries shown on the screen.

f3 = "Brief" — Displays a screen showing the present configuration of the Brief array for this battery.

f4 = "Timers" — Displays a screen similar to that shown in Figure 15. Enables the operator to make changes to the Cycle Timer Table.

f5 = "Up" — Moves the highlight up one row location.

f6 = "Left" — Moves the highlight to the left one column.

f7 = "Right" — Moves the highlight to right one column.

Table 6. BRIEF.DAT Data File

Battery ID#	CONFIG.DAT Position	Line Unit Address	Configuration Table Position
935	1	23	1
934	19	23	18
933	37	23	35
932	55	23	52
931	73	23	69
930	91	23	86
450	109	24	1
451	127	24	18
	through		
500	739	29	86
510	757	30	1
511	775	30	18
512	793	30	35
513	811	30	52
514	829	30	69
515	847	30	86

ID 515 D A   MFGR CSPLCELLV   CAPACITY. 10   MODE WAIT

CHANNEL TYPE	SCANNER CHANNEL	CALIBRATION FACTOR	HIGH VOLTAGE LIMIT	LOW VOLTAGE LIMIT
BATTERY VOLTAGE	V24	1-.05	4 0	1.3
BATTERY CURRENT	A25	1000-.30	12	0
BAT TC (-TYPE,	T72-K	1- 50	400	300
CELL VOLTAGE #1	T109-K	1-.05	400	300
CELL VOLTAGE #2	T110-K	1-.05	400	300
CELL VOLTAGE #3	T111-K	1- 05	400	300
CELL VOLTAGE #4	-1	1- 05	3	0
CELL VOLTAGE #5	-1	1- 05	3	0
CELL VOLTAGE #6	-1	1-.05	3	0

CONNECT/DISCONNECT RELAY	CHARGE/DISCHARGE RELAY	CYCLE TIMER (min.s)	CYCLES PER SET
6	7	0	3

Select Desired Function (Type EX to exit)

MODIFY | STORE | BRIEF | TIMERS | UP | LEFT | RIGHT | DOWN

Figure 14. Battery Test Configuration Table

```
                    Config ID # :  513

Brief ID #    :  513    Should match Config ID #
Config Position :  397    Corresponds to Config block for this ID #
LU Address   :  25    Line Unit where battery is located
Device Position :  52    Corresponds to Config block for ID # at LU

Select one of the following keys to modify the assignment entries

f1 => To modify Brief ID #
f2 => To change Config block pointer for this ID #
f3 => To Line Unit where battery is located
f4 => To change Line Unit Config block pointer for this ID #

--- SELECT OPTION ---
```

Figure 15. Brief Array Screen

f8 = "Down"	Moves the highlight down one column.

To exit from this screen and return to CONFIG's main menu type in EX and press the ENTER key.

Procedure 2.1 Changing Configuration Entries (Modify key)

Use the UP, LEFT, RIGHT, and DOWN special function keys to highlight the entry you wish to change. If you are changing the battery's identification number, you don't need to include the test station type (RELAY or D/A). But, you will have to make the corresponding change to the battery's ID# in the Brief array. This will be covered in Procedure 2.3.

Once the entry to be changed is highlighted, press the MODIFY key (f1). The entry will then start blinking and a message showing the present value for this entry will be displayed across the bottom of the screen. This message looks similar to the following:

PRESENT VALUE: xxxxxx, ENTER NEW VALUE (10 characters max.)

Enter the new value and press ENTER key. If this change was to the battery's test mode entry, CONFIG would check its spelling for legal test mode entries. If CONFIG finds that this is an invalid test mode, it will be changed to the INACTIVE mode.

Procedure 2.2 Saving Configuration Entries (Store key)

This operation is very simple; just press the STORE key (f2). This transfers all the entries listed on the screen to the Test Configuration Table. The Test Configuration Table is then updated on disc. The disc file where it is stored is called CONFG.DAT and is located in the /OPERATIONS directory.

Procedure 2.3 Changing Brief Array Entries (Brief key)

Brief array entries should be changed whenever a change has been made to the battery's identification number or when battery test stations or LUs are changed.

When selecting the BRIEF key (f3), a new screen appears similar that shown in Figure 15. The Config ID# entry comes from the previous screen (configuration array). The Brief ID# is the battery ID# contained in the brief array for this configuration array block. The Config ID# and the Brief ID# should be the same; if not, one must be changed. The Config Position entry is a value that points to the starting row number within the Test Configuration Table where the configuration array for this battery exists. The LU Address value corresponds to the LU where the battery is located. The Device Position value points to the starting row number within the Battery Test Configuration Table at the LU where the battery's configuration array is located.

These entries are all used when transferring a test configuration for a battery to its LU or when updating the Configuration Table within the CONFIG program.

Once changes to the Brief screen have been made, they must be saved on disc. To do this, press the STORE key (f7). Notice the ModifyC key (f5); this is used to change the Config Position and Device Position entries that are saved in the last row of the battery's configuration table. These entries should never have to be changed.

Procedure 2.4 Creating Cycle Tests (Timer)

When selecting the TIMER key (f4), a new screen entitled Cycle Timer Table appears. This screen looks similar to that shown in Figure 16. Through this screen Battery Tests are configured. Refer to Section 3.1.2 for a discussion on the contents of the Cycle Timer Table.

ID# 515 D/A Cycle Timer Configuration Table

Use special function keys to create or modify entries (-L erases last entry)

Present - MODES	Times (min.s)	New - MODES	Times (min.s)
WAIT	— 5		
POWER1	— 2000-1.88V1.3		
WAIT1	— 5		
CHARGE1	— 400-2.4V2		

INIT	WAIT	CHARGE	DISCHG	POWER	SHORT	CAP	EXIT

Figure 16. Cycle Timer Configuration Table

The contents of the Cycle Timer Table are contained within rows 12 through 17 of the battery's configuration array. Associated with this screen is a new set of special function key assignments that are used in the construction of battery test periods. The following is a list of these assignments.

f1 = "INIT"	Enables initial cycle test periods.
f2 = "WAIT"	Generates Wait test periods.
f3 = "CHARGE"	Generates Charge test periods.
f4 = "DISCHG"	Generates Discharge test periods.
f5 = "POWER"	Generates Constant Power Discharge periods.
f6 = "SHORTOUT"	Generates Shortout/Strip test periods.
f7 = not assigned	
f8 = "EXIT"	Returns to previous screen.
-L =	Erases the last test period entry in the list.

The Cycle Timer Table screen contains two columns of battery test periods. The left column contains the present contents of the Cycle Timer Table. The right column lists new test periods as they are selected. To select a test that is presently listed in the left column, press the ENTER key.

Note that before CONFIG will accept new test period entries, the following question will be asked:

Is the test station where this battery located under RELAY or D/A control: (enter RELAY or D/A)

All test stations within the Battery Test Facility are under D/A control. During special test conditions, this can be changed to be under RELAY control.

To construct new test periods, simply press the special function key that corresponds to the type of test period to be generated. To construct an initial wait, charge, or discharge test period, press the INIT key (f1) and simply select the test period to go along with it. Refer to Section 3.1.7.1, Procedure 7, for input on how to answer test period generation questions.

Procedure 3. Transferring Configuration Table (Dnload)

The Download process is used to remotely start, stop, or change battery test operations at the LUs. This is accomplished by transferring selected portions of the Test Configuration Table to their assigned LUs.

To initiate this process, press the DNLOAD key (f3). The following is requested.

Enter ID# of battery configuration array to be Downloaded: (enter 0 for an initial download operation)

There are two options available at this point. The first is to select a battery ID# and transfer its configuration block to the battery's assigned LU. The second is to select an LU; this is used when the LU is being started from scratch. This option transfers all battery configuration blocks assigned to the selected LU to that LU.

After selecting the download option, the CONFIG program schedules the IOPROG program and suspends until completion of IOPROG. The IOPROG program has a high priority (51).

Program priority is based on a time-slice fence 50, with 1 being the highest priority. All programs have time-slice priorities; the default is 99. User-written programs lie between 50 and 32767. Programs of lower priorities are candidates to be swapped to disc to make room for programs having higher priorities.

With IOPROG having a priority of 51, it is allowed to run to completion. This is important because IOPROG performs all the I/O interactions with the LUs where bus timing is critical.

Procedure 3.1 Initial Download Operation

During an initial download operation, an additional operation takes place. CONFIG asks for the LU where the configuration array is to be transferred. The prompt looks something like the following:

Identify the Line Unit where initial download will occur:

Enter the LU number where the transfer will occur. After entring this, CONFIG suspends so that the operator has time to start the selected LU. Refer to Section 3.1.7.1, Procedures 1 through 4, for instructions on how to do this. The following message is displayed at this point:

Make certain the selected Line Unit is ready then press KEY f4 to continue.

After completing the procedures outlined in Section 3.1.7.1 and pressing the f4 key, the following message is displayed:

Downloading of configuration array to Line Unit: xx

At this point, an initial I/O code of 1 is sent to the selected LU to indicate the type of I/O operation that will take place. The LU (NEWBT) receives this code, enables an interrupt based on it, and suspends 10 seconds. At this point, the following message will be blinking on the screen:

Waiting for SRQ from device: xx

Status byte not received: 0

After suspending for 10 seconds, the LU (NEWBT) pulses the SRQ line of the HP-IB interface bus. IOPROG detects this and displays the following:

Status byte received: 64

IOPROG then sends the Device Position pointer for the first battery to the LU. This tells NEWBT where in its Battery Test Configuration Table the forthcoming data is to be placed. IOPROG then sends the configuration array data, one row at a time (4 elements). After completing the transfer of the first battery test configuration block, the Device Position pointer for the next block is sent. This operation continues until the last block of data has been transferred. IOPROG then sends a -1 to the LU (NEWBT) indicating the transfer is complete. IOPROG then completes and CONFIG resumes.

Procedure 3.2 Download Operation of a Single Battery

When downloading a configuration array for a single battery, IOPROG assumes that the LU where the operation is to take place is operating NEWBT normally. After selecting a battery ID# to be downloaded, the following questions are asked as illustraed in Figure 17.

Select the Cycle Timer operation required for the type of download operation being done. Normally when starting a new battery test, 1 should be selected. A value of 2 or 3 is selected when continuing a battery test that is presently in progress. Once this question has been answered another is asked:

Do you wish to reset the Ahr and Whr arrays associated with this battery?

Here again, normally when starting a new battery test, this question should be answered Y. But, when continuing a battery test, answer this N. After these questions are answered, the IOPROG displays the following:

Downloading of configuration array for battery ID#: xxx

At this point an initial I/O code of 1 is sent to the selected LU, which tells NEWBT the type of I/O operation that will take place. The LU (NEWBT) receives this code and enables an interrupt based on it. At this point, the following message is blinking on the screen:

Waiting for SRQ from device: xx

Status byte not received: 0

This message will continue to blink until the status byte is received by IOPROG. The LU (NEWBT) will pulse the SRQ line of the HP-IB interface bus after its next scan operation, normally in about 60 seconds. When IOPROG receives the SRQ pulse, it displays the following:

Status byte received: 64

IOPROG then sends the Device Position pointer for this battery to the LU. This pointer indicates where in NEWBT's Test Configuration Table this data is to be placed. It then sends the configuration array for the battery,

Cycle Test Timer Selections for ID#: 515

Code	Operation
1	Reset Cycle Test Timer
2	Use Cycle Test Timer Contained in Config.
3	Do Not Reset Cycle Test Timer

Enter code number of Cycle Test Timer operation to be used:

Figure 17. Cycle Test Timer Reset Selections

one row at a time (4 elements). After the last row of data is sent, IOPROG sends a -1. This tells NEWBT that the transfer is complete. IOPROG then completes and CONFIG resumes.

Procedure 3.3 Possible Errors During Dnload Operations

During the Download process, there are several errors that may occur.

(1) The first and most likely would be a warning like the following:

WARNING—No I/O operations allowed at this time!

This occurs when a system common variable named ISTATUS is equal to -1. The ISTATUS flag is used to disable I/O operations when one is already taking place. This flag is used mainly because the HP1000 computer system is a multiuser multitasking machine and it is possible to have two persons trying to execute an operation at the same time.

This message will blink on and off for about 15 seconds. IOPROG then aborts the I/O operation and you return to CONFIG's main menu. At this point exit from CONFIG by pressing the EXIT key (f8). Execute a program called TEST1. This program lists all the system common variables that pertain to I/O operations. The screen looks similar to Figure 18.

To change the -1 ISTATUS flag, enter a value of 1, and press ENTER. Another question appears similar to the following:

Do you wish to change the Line Unit list (LUS entries, Y or N)?

Enter N; this completes the TEST1 program. Now CONFIG can be run and the I/O operation will be allowed.

(2) The I/O operation times out, and the following message appears:

An I/O problem was encountered with Line Unit: xx. The failure occurred while downloading Config. Service this Line Unit and retry I/O operation.

Press KEY 4 (f4) to continue !!!, IERR= xxx

This error occurs sometimes for no apparent reason. To recover from this, press the f4 key. This aborts the I/O operation and resets the

LUS(1): 24
LUS(2): 25
LUS(3): 26
LUS(4): 27
LUS(5): 28
LUS(6): 29
LUS(7): 0
IMODE(1): -25
IMODE(2): 514
ICNTL: 9
HPIB bus status code ISTATUS: -1 Enter new value:

Figure 18. TEST1 Program

HP-IB interface bus. CONFIG's main screen will appear.

Now go over to the LU that caused the error. If NEWBT is suspended due to a software error and the error is 167 or 168, simply continue the program. If the error was something other than 167 or 168, then correct the error and continue the program. Once NEWBT's main screen appears, press the RESET I/O key (f5). This resets the LU's HP-IB interface and enables I/O interrupts.

(3) The following message continually blinks for more then 5 minutes:

Waiting for SRQ from device: xx

Status byte not received: 0

To recover from this condition, press the ENTER key (at HP1000) until a CM prompt appears. Then type OFF and press the ENTER key. This aborts the IOPROG program and returns to CONFIG's main menu screen. Now go to the LU where the I/O operation was to take place. Press the RESET I/O key (f5), this resets all I/O flags and enables I/O interrupts. The I/O operation can now be retried.

Procedure 4. Updating Test Configuration Table (STATUS)

This operation is used to update the Test Configuration Table within CONFIG. It also generates a listing that summarizes the battery test activities that are occurring on the selected LU. To initiate this process, press the STATUS key (f4) on CONFIG's main menu. The following question is asked:

Enter Line Unit # where status will be taken:

Enter the LU number where this operation is to take place. The following message will then be displayed:

Requesting Test Status Information for Line Unit: xx"

At this point an I/O code of 3 is sent to the LU. This code number indicates to the NEWBT the type of I/O operation that is to take place. The LU (NEWBT) receives this code and enables an I/O interrupt based on it. At this point, the following message is blinking on the screen:

Waiting for SRQ from device: xx

Status Byte Not Received: 0

After about a minute (after NEWBT completes a scan operation), NEWBT pulses the SRQ line of the HPIB interface bus. IOPROG detects this and displays the following:

Status Byte Received: 64

IOPROG then sends the Device Position pointer of the first configuration block to be transferred. NEWBT receives this pointer and sends its corresponding configuration block data to IOPROG.

After receiving this block of data, IOPROG compares the battery ID# of the data received to what is presently contained in CONFIG's Test Configuration Table for this block of data. If different, a message is printed indicating this. CONFIG's Test Configuration Table for this block of data is replaced with the block of data received from the LU. The operation is then repeated for all six test station locations.

After completion of the transfer and update process, a listing is generated that shows the present test status of all batteries contained on the LU. Once the printout is complete, IOPROG terminates and CONFIG's main menu screen is displayed.

If any errors occur during this process, refer to Section 3.2.4.1, Procedure 3.3, for instruction on how to correct and continue from the error.

Procedure 5. Generating 24-hour Graphs (PLOT)

This procedure is used to generate graphs of battery voltage and current versus time for the last 24 hours of any battery under test within the Battery Test Facility. The data for these graphs are saved within each LU's NEWBT program buffer named IBUF. This array is 72 columns by 144 rows. The array is divided into six groups. Each group contains 12 columns of data. The following identifies the type of data contained in each column.

Column 1	Date of Data Generation
2	Time of Data Generation
3	Minutes Into Year of Data Generation
4	Battery Voltage
5	Battery Current
6	Battery Temperature
7	Voltage Monitor 1
8	Voltage Monitor 2
9	Voltage Monitor 3
10	Voltage Monitor 4
11	Voltage Monitor 5
12	Voltage Monitor 6

The 144 rows (or records) of data correspond to 1440 minutes of a 24-hour period. Data records are saved every 10 minutes, thus the 144 rows. Data records are also saved every time a test period starts or stops, a software limit is reached, or NEWBT errors or pauses.

When this operation is executed, CONFIG schedules the PLTR48 program. PLTR48 is divided into two groups of software code. The first group contains I/O routines used in reading the data from the LUs. The second group contains all the routines used in generating the graph.

After selecting the PLOT key (f5), the following message appears on the screen:

Enter ID# of battery you wish to plot:

Enter the ID# to be graphed and press the ENTER key. PLOT48 then displays the following:

Requesting data for the last 24 hours on battery ID:

At this point, an I/O code of 6 is sent to the selected LU that tells NEWBT the type of I/O operation that will take place. The LU (NEWBT) receives this code and enables an I/O interrupt based on it. At this point the following message is blinking on the screen:

Waiting for SRQ from device: xx

Status Byte Not Received: 0

After about a minute (after NEWBT completes a scan operation), NEWBT pulses the SRQ line of the HP-IB interface bus. IOPROG detects this and displays the following:

Status Byte Received: 64

PLOT48 then sends the Device Config Position pointer to the LU (NEWBT). NEWBT selects the group of data and sends it to PLOT48. After all 144 records of data are received, PLOT48 generates the graph. The screen looks similar to that shown in Figure 19.

Associated with this screen are special function key assignments. The following outlines the function of each key assignment.

f1 = "→"	Moves left expand pointer to the left one data point.
f2 = "←"	Moves left expand pointer to the right one data point.
f3 = "→"	Moves right expand pointer to the left one data point.
f4 = "←"	Moves right expand pointer to the right one data point.
f5 = "PLOT"	Redraws original graph.
f6 = "EXPAND"	Redraws graph with data contained between left and right pointers.
f7 = "COPY"	Generates a hard copy of the graph on the terminal default printer.
f8 = "EXIT"	Terminates PLTR48 and turns to CONFIG.

Through the use of special function keys f1-f4, and f6, portions of the graph can be selected and expanded. When either expand pointer is selected, a "V" appears on the graph. There are left and right expand pointers. The "V" points to actual data points on the graph. Once the pointers are moved to the portion of the graph to be expanded, press the EXPAND key (f6). This redraws the graph based on the data contained between the two pointers. To return to the

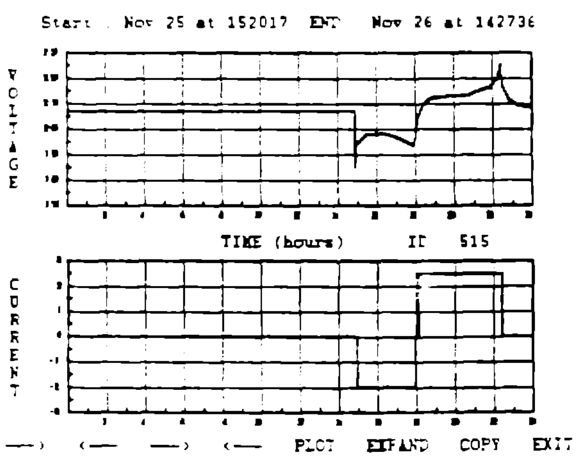


Figure 19. PLTR48 Screen

original graph, press the PLOT key (f5). A hard copy of the graph appearing on the screen can be obtained by pressing the COPY key (f7).

If errors occur during this process, refer to Section 3.2.4.1, Procedure 3.3, for instructions on how to correct and continue from the error.

Procedure 6. Battery Test Data Transfers (Update)

This procedure is used to transfer battery test data from LUs into CONFIG's RDATA.DAT file. The battery test data is read from the 3.5" data discs contained at each LU location. The transfer begins at the value of NEWBT's PNTR pointer and ends with the L pointer. For a complete discussion on the contents of a battery test data record, refer to Section 3.1.3 entitled Battery Test Data Records.

To initiate this process press the UPDATE key (f6). The following is requested:

Enter Line Unit number where data transfer will occur:

Select a LU and press the ENTER key. CONFIG then schedules the UPDATE program and suspends. As with the IOPROG program, UPDATE also has a high program priority. Refer to Procedure 3 of this section for a discussion of program priorities.

Once the UPDATE program is scheduled, the following message is displayed:

Requesting Data Transfer From Line Unit: xx

At this point an I/O code of 2 is sent to the LU. This code is received by the LU (NEWBT) and enables an I/O interrupt based on it. UPDATE displays the following:

Waiting for SRQ from device: xx

Status byte not received: 0

After the completion of the next SCAN operation by NEWBT, it pulses the SRQ line of the HP-IB interface bus. UPDATE detects this and displays the following message:

Status Byte Received: 64

UPDATE then opens the RDATA.DAT file and tells NEWBT to send it the values of the PNTR and L pointers. UPDATE then sets up a FOR/NEXT loop based on these pointers. UPDATE then tells NEWBT to send it the first record of battery test data. Once the information is received, it is placed in the RDATA.DAT. UPDATE then tells NEWBT to send the next record's data. This process continues until PNTR is equal to L, at which point UPDATE sends NEWBT a value of -1. NEWBT is set up to terminate the data transfer when receiving this value. UPDATE then updates the header record contained in the RDATA.DAT and terminates.

The header record of the RDATA.DAT file is contained in record 1. This record is configured as follows.

Element 1 =	Fill pointer for this file (last record stored).
2 =	Maximum number of possible within this file.
3 =	Date of first battery test record stored in file.
4 =	Time of first battery test record stored in file.
5 =	Date of last battery test record stored in file.
6 =	Time of last battery test record stored in file.

If errors occur during this process, refer to Section 3.2.4.1, Procedure 3.3, for instructions on how to correct and continue from the error.

3.3 DBAT Image Database System

The DBAT Image Database System is a collection of related data files containing much of the battery test data acquired by the testing process within the Battery Test Facility. The DBAT Database utilizes the Image/1000 Database Management file structure that resides in the HP1000 Central Computer.

3.3.1 What is a Database?

A database is a collection of logically related files containing both data and structural information. Pointers within the database allow users to gain access to related data and to index data across files.

3.3.2 Why Use a Database?

The primary benefit derived from the use of the Image Database Management System is time savings. These savings are typically shown in file consolidation, program file independence, versatility, data security, and program development.

File Consolidation – Most information processing systems that service more than one application area contain duplicate data. File consolidation into a database eliminates most data redundancy. Through the use of pointers, logically related items of information are chained together, even if they are physically separated. Through the use of logical associations, data could be used by any program needing it. Since there is only one record to retrieve and modify, the time requiring the data manipulation is greatly reduced.

Program File Independence – Image allows the data structure to be independent of the application program. Data item relationships are independently defined. Changes in the database structure need only be incorporated into those programs that manipulate the changed data.

Versatility – Conventional file organization techniques allow limited access to the data they contain. Image allows data to be accessed through a variety of methods. Data Security - Image provides security at the file and data item level.

Program Development – The database structure can be defined and built without the use of special purpose application level programming. Since control of the linkage portion of the database is under Image software control, the programmer need not be concerned with testing the structure and can concentrate on the functional programming task at hand.

3.3.3 Database Structure

3.3.3.1 Database

An Image database consists of one or more data sets which have some logical relationship to one another. These data sets are stored on disc as File Manager Program (FMP) files. A data set consists of one or more fixed length data entries (logical records). A data entry consists of one or more data items (fields).

3.3.3.2 Data Items

A data item is the smallest accessible data element in a database. Each data item consists of a value referenced by a data item name, typically selected to describe the data value. In general, several item values are referenced by the same data item name, each value existing in a different data entry.

3.3.3.3 Compound Data Items

A compound data item is a named group of identically defined, adjacent items within the same data entry. Each occurrence of the data item is called an element and each element may have a value.

3.3.3.4 Data Types

The database designer defines each data item as a particular type depending on what kind of information is to be stored in the item. It may be integer, real, or ASCII character information.

3.3.3.5 Data Entries

A data entry is an order set of data items. The order of data items in an entry is specified when the database is defined with at most 127 data item names, none of which is repeated within the entry. The length of the data entry is the sum of the lengths of the data items it contains. When the entry is stored in the database, additional structural information will be added to form the complete record.

3.3.3.6 Data Sets

A data set is a collection of data entries, called occurrences, where each entry contains values for the same data items. Each data set is referenced by a unique data set name. Each data set is stored in one disc file consisting of storage locations called records.

3.3.3.7 Master Data Sets

Master data sets are characterized in the following ways:

- They are used to keep information relating to a uniquely identifiable entity.
- They allow for rapid retrieval of a data entry since one of the data items in the entry, called the key item, determines the location of the data entry.
- They can be related to detail data sets containing similar key items and thus serve as indicators to the detail data set.

3.3.3.8 Detail Data Sets

Detail data sets are characterized in the following ways:

- They are used to record information about related events.
- They allow retrieval of all entries pertaining to a uniquely identifiable entity.

The storage location for a detail data set entry has no relation to its data content. When a new data entry is added to a detail data set, it is placed in the first available location. Unlike a master data set which contains at the most one key item, a detail data set may be defined with from zero to sixteen key items.

Image stores pointer information with each detail entry which links together all entries with the same key item value. Entries linked together in this way form a chain. A key item is defined for a detail data set if it is desired to access all entries with a common key item value, in others, all entries in a chain.

3.3.3.9 Sorted Chains

A chain consists of all detail data set entries accessed through the same key item value. Image contains a sorted chain feature that places entries in a chain in ascending order, sorted by the value of any other item in the entry.

3.3.3.10 Paths

A master data set may have only one key item and it may be related to one or more detail data sets. The key items in master and detail sets must be of the same type and size. This relationship forms a path. A detail data set can have up to 16 key items, linking it up to 16 different master data sets.

For each path from a master data set, there is a chain for each key item value. This chain consists of all detail set entries whose key item along a path equals the related master set's key item value. The master entry contains pointer information to the chain.

3.3.3.11 Automatic and Manual Masters

A master data set may be automatic or manual. The DBAT Database is configured with both manual and automatic master data sets. Manual masters are used to ensure that valid key values are entered for related detail entries. Automatic masters are used to save time when key item values are unpredictable or so numerous that manual addition and deletion of master entries is undesirable. The following is a list of manual and automatic master characteristics:

Manual masters are defined in the data schema as having zero data paths. With this configuration, a manual master serves as a special type of detail data set: one that is randomly organized, one that is not linked to any master data sets, or one in which each data entry contains a unique value for the key item.

3.3.3.12 Database Files

All database elements are stored in RTE FMP files. The files are created during database generation. The security code for all database files is the same as the security code specified for the database. The root file of a database serves as the common point of entry to, and source of information about, the database files. There is one data file for each data set. At creation time, the size of each record and number of records in each data file are determined by information contained within the root file.

3.3.4 DBAT Database Structure

The DBAT Image Database is constructed with 1 manual master data set, 2 Automatic master data sets, and 8 detail data sets. DBAT contains 106 defined data items. Table 7 lists all data items contained within the DBAT Image Database system.

The manual master IDMAS contains general information about each battery contained within the database. When a new battery is added to the system, the test operator executes a program called NEWID. This program asks a series of questions about the type of battery to be added and its basic test operating parameters. IDMAS also keeps track of when the battery was added to the system and the last date it was updated.

The two automatic masters, named DATE and CYCLE have chains linking them to all detail data sets. For example, if a change was made to either the Date or Cycle data items, this change would be reflected throughout the detail data sets. These chains also speed up data search and sort operations.

Figure 20 illustrates the organizational structure of the DBAT Image Database layout. Note the chains linking the detail data sets.

Manual Master	Automatic Master
May stand alone. Need not be related to any detail data set.	Must be related to one or more detail data sets.
May contain data items in addition to key items.	Must contain only the key item.
Entries must explicitly be added or deleted. A related detail data entry cannot be added until a master entry with matching key item value has been added. When the last detail entry related to a master entry is deleted, the master entry still remains in the data set. Before a master entry can be deleted, all related detail entries must be deleted.	Image automatically adds or deletes entries when needed based on the addition of related detail data set entries. When a detail entry is added with a key item value different from all current key item values, a master entry with a matching key value is automatically added. Deletions of detail entries trigger an automatic deletion of the matching master entry if it is determined that all related data chains are empty.

Table 7. DBAT Database Defined Data Items

Name	Type	Description
ID#	I1(1,15)	Battery ID Number
MANF	X20(1,15)	Manufacturer
STDAT	I1(1,15)	Start Test Date
ETDAT	I1(1,15)	End Test Date
LUDAT	I1(1,15)	Last Data Update Date
TOTCY	I1(1,15)	Total # Of Cycles
TOTCC	I1(1,15)	Total # Of Capacity Cycles
CELL#	I1(1,15)	# Of Cells In The Battery
MFGID	X10(1,15)	Manufacturer's ID Number
SBMID	X40(1,15)	Sub Module ID Number
BTYPE	X20(1,15)	Battery Type
TMODE	X20(1,15)	Test Mode
TSTAT	X10(1,15)	Test Station Number
RCAP	R2(1,15)	Rated Capacity In Amphours
INCAP	R2(1,15)	Initial Capacity In Amphours
INWHT	R2(1,15)	Initial Electrolyte Weight
CHGV	R2(1,15)	Charge Voltage
CHGI	R2(1,15)	Charge Current
FCHGI	R2(1,15)	Final Charge Current
FINCI	R2(1,15)	Finsh Current
COFV	R2(1,15)	Charge Cutoff Voltage
DCHGV	R2(1,15)	Discharge Current
SPGRV	R2(1,15)	Specific Gravity
RTD#	I1(1,15)	Real-Time Disc #
RTR#	I1(1,15)	Real-Time Record #
DATE	I1(1,15)	Date
CYC#	I1(1,15)	Cycle Number
FLAG	I1(1,15)	Test Flag
TIME	R2(1,15)	Time Of Data
DAH#1	R2(1,15)	1st Discharge Amphours
CAH#1	R2(1,15)	1st Charge Amphours
DWH#1	R2(1,15)	1st Discharge Watthours
CWH#1	R2(1,15)	1st Charge Watthours
DAH#2	R2(1,15)	2nd Discharge Amphours
CAH#2	R2(1,15)	2nd Charge Amphours
DWH#2	R2(1,15)	2nd Discharge Watthours
CWH#2	R2(1,15)	2nd Charge Watthours
AHEFF	R2(1,15)	Amphour Efficiency (Discharge#2/Charge#1)*100
EOCAT	R2(1,15)	End of Charge Ambient Temperature
CYCTY	R2(1,15)	Cycle Type Parameter
SPAR4	R2(1,15)	Spare Data Item #4
SPAR5	R2(1,15)	Spare Data Item #5
SPAR6	R2(1,15)	Spare Data Item #6
SPAR7	R2(1,15)	Spare Data Item #7
SPAR8	R2(1,15)	Spare Data Item #8
SPAR9	R2(1,15)	Spare Data Item #9
SPAR10	R2(1,15)	Spare Data Item #10
SPAR11	R2(1,15)	Spare Data Item #11
SPAR12	R2(1,15)	Spare Data Item #12
SPAR13	R2(1,15)	Spare Data Item #13
SPAR14	R2(1,15)	Spare Data Item #14
DCV1	R2(1,15)	End of Discharge Voltage Cell1
DCV2	R2(1,15)	End of Discharge Voltage Cell2
DCV3	R2(1,15)	End of Discharge Voltage Cell3
DCV4	R2(1,15)	End of Discharge Voltage Cell4
DCV5	R2(1,15)	End of Discharge Voltage Cell5
DCV6	R2(1,15)	End of Discharge Voltage Cell6
CCV1	R2(1,15)	End of Charge Voltage Cell1
CCV2	R2(1,15)	End of Charge Voltage Cell2
CCV3	R2(1,15)	End of Charge Voltage Cell3
CCV4	R2(1,15)	End of Charge Voltage Cell4
CCV5	R2(1,15)	End of Charge Voltage Cell5
CCV6	R2(1,15)	End of Charge Voltage Cell6
CYCPS	R2(1,15)	Cycles Per Set
EODVS	R2(1,15)	EOD Voltage, Start of Cycle Set
EODVE	R2(1,15)	EOD VOLTAGE, End of Cycle Set
DELTA	R2(1,15)	Delta EOD Voltage = EODVS-EODVE
EODSP	R2(1,15)	EOD Voltage Spread = EODVS-SODVE
AVAHE	R2(1,15)	Average Amphour Efficiency During Cycle Set
AVWHE	R2(1,15)	Average Watthour Efficiency During Cycle Set
COMMT	X238(1,15)	Computer Status Comment
OCBV	R2(1,15)	Open Circuit Battery Voltage
CELT	R2(1,15)	Cell Electrolyte Temperature
CELLV	R2(1,15)	Cell Voltage
CELSP	R2(1,15)	Cell Specific Gravity
ADWHT	R2(1,15)	Adjusted Weight

Table 7. DBAT Database Defined Data Items (continued)

Name	Type	Description	Name	Type	Description
WHEFF	R2(1,15)	Watthour Efficiency (Discharge#2/Charge#1)*100	TAHRM	R2(1,15)	Total Amphours Removed
PCIC	R2(1,15)	% Initial Capacity	TAHRT	R2(1,15)	Total Amphours Returned
WGHT	R2(1,15)	Weight in Kg	GMPCY	R2(1,15)	Grams Weight Loss Per Cycle
AHREM	R2(1,15)	Amphours Removed	PCACC	R2(1,15)	percent Accumulated Weight Loss
AHRET	R2(1,15)	Amphours Returned	ELCAD	R2(1,15)	Electrolyte Added
WHREM	R2(1,15)	Watthours Removed	TWTLS	R2(1,15)	Total Weight Loss
WHRET	R2(1,15)	Watthours Returned	ELCWT	R2(1,15)	Electrolyte Weight
EODV	R2(1,15)	End of Discharge Voltage	GMPST	R2(1,15)	Grams Weight Loss Per Set
EODC	R2(1,15)	End of Discharge Current	WSPAR	R2(1,15)	Spare Weight Item
EODT	R2(1,15)	End of Discharge Temperature	SDSGD	I1(1,15)	Discharge Start Date
EODAT	R2(1,15)	End of Discharge Ambient Temperature	SDSGT	R2(1,15)	Discharge Start Time
EOCV	R2(1,15)	End of Charge Voltage	EDSGD	I1(1,15)	Discharge End Date
EOCC	R2(1,15)	End of Charge Current	EDSGT	R2(1,15)	Discharge End Time
EOCT	R2(1,15)	End of Charge Temperature	SCHGD	I1(1,15)	Charge Start Date
			SCHGT	R2(1,15)	Charge Start Time

NOTE: I1 signifies an Integer type variable.
R2 signifies a Real number variable.
Xnnn signifies a Character string entry, nnn characters in length.

The DBAT Image Database System contains most of the battery data generated by the testing activities within the Battery Test Facility. Test data is organized into data files as Figure 20 illustrates.

Detail data set #4, CAPACITY DATA, contains all test information that pertains to capacity test cycles. Capacity test cycles have not been executed since 1985. They were developed in order to determine the rated capacity of Lead-Acid type batteries. Data for this set can be manually or automatically entered.

Detail data set #5, ALARM DATA, contains data from most battery test alarm conditions in the test facility. Data is put into this data set whenever a software alarm limit is reached. For example, high temperature alarms, low battery voltage alarms, etc. Data for this set can be manually or automatically entered.

Detail data set #6, SUMMARY DATA, summarizes battery cycle test data. This is used in determining the long term test performances for each battery. Data for this set can be manually or automatically entered.

Detail data set #7, COMPUTER STATUS, contains text entries about any special event concerning the battery in question. These entries are generated by manual user input. A typical entry may concern when a battery was moved from one test location to another. The entry may pertain to the operation of a LU that affected a battery's test results.

Detail data set #8, SPECIFIC GRAVITY, contains specific gravity data when readings are made on Lead-Acid batteries. Data for this set is manually entered.

Detail data set #9, CYCLE DATA, contains battery cycle test data generated in the test facility. This is where the bulk of all test data resides. Data for this set can be manually or automatically entered.

Detail data set #10, CELL DATA, contains the cell voltage data that go along with the data contained in set #9. Data for this set can be manually or automatically entered.

Detail data set #11, WEIGHT DATA, contains weight data for each battery for use in calculating battery weight loss per cycle. Battery weights are manually entered into this data set.

3.3.5 Using the DBAT Image Database System

The DBAT Image Database can be accessed either manually or through the use of user-written command files or programs. To manually open the database and access

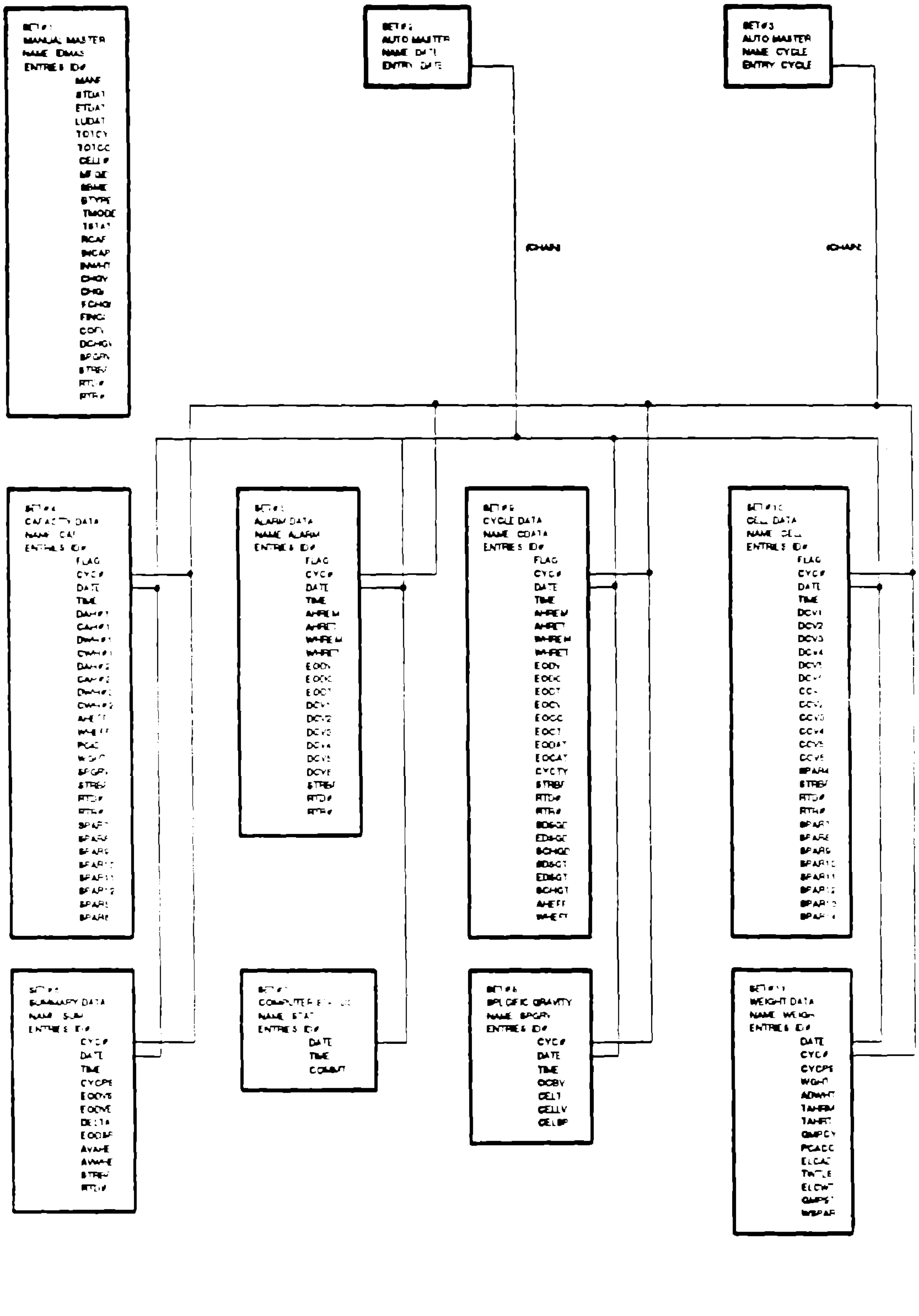


Figure 20. DBAT Image Database Structure

data contained in the detail data sets, the IMAGE/1000 program called Query must be executed.

3.3.5.1 Query

Query is an interactive program that provides simple access to the Image database without programming effort. The Query program can be used to store data, modify or delete data entries, or retrieve selected data entries; generate a report listing on selected data entries.

Note: For a complete discussion on operator access using Query, refer to chapter 3 of the IMAGE/1000 Reference Manual.

Once the database is open, there are a number of Query commands that provide easy access to the database. The follow lists of commands are available to the Query operating.

Commands that open and define the database:

* DATA-BASE = Defines the database being opened
* SELECT-FILE = Selects a data set to be accessed.

Commands that control locking of database during its usage:

* TRANSBEGIN = Locks the database
* TRANSSEND = Unlocks the database
* TRANSUNDO = Unlocks the database.

Command to locate data items for retrieval and manipulation:

* FIND = Retrieves data entries from the database.

Commands to manipulate data entries:

* UPDATE = Adds, deletes, or replaces data entries. Command to generate reports from data entries in the database
* REPORT = Prints data entries retrieved via the FIND command.

Commands to create and use Query command files:

* CREATE = Selects a procedure and stores it in a disc file
* DISPLAY = Lists a Query command file stored on disc
* EXECUTE = Executes a Query command file
* DESTROY = Removes a Query command file from disc
* XEQ = Allows the user to execute commands from a command file.

User assistance and utility commands:

* FORM = Generates a listing defining database structure and identifies all links
* HELP = Lists all Query commands
* LIST = Identifies the list out device for Query reporting
* EXIT = Terminates Query.

3.3.5.2 Opening the DBAT Database

To open the DBAT Database perform the following:

CI > QUERY

NEXT? DATA-BASE = DBAT:2525:16;

LEVEL = ? SECUR;

OPEN MODE = ? 3;

The database is now opened and ready for use. Information concerning the present status of the database can be obtained through the use of the FORM command. Simply enter the following:

NEXT? FORM;

To access data contained in the data sets, a data set must first be selected. To do this enter the following:

NEXT? SELECT-FILE= name of data set

Now, any one of the following commands can be executed on the selected data set or other data sets by reissuing the SELECT-FILE command.

* FIND = Retrieve data entries from a data set
* REPORT = Prints a formatted list on select data entries retrieved by the FIND command
* UPDATE = Adds, deletes, or modifies data entries selected by the FIND command.

To retrieve data from a selected data set, use the FIND command. Refer to page 3-11 of the IMAGE/1000 Reference Manual for complete discussion on this command. For example, to retrieve all data entries contained in the IDMAS manual master data set, enter the following:

NEXT? FIND IDMAS.ID# IGT "0" END;

Query checks the value of each ID# data entry and records those that satisfy the search expression. At the completion of this command, Query displays the number of entries that qualified for this search expression.

There are two methods to list this data. The first is to manually run the REPORT command. Refer to pages 3-23 through 3-47 of the IMAGE/1000 Reference Manual for details on how this is done. The second is to use the XEQ command to execute procedure files that interactively invoke the REPORT command.

Procedure files provide a convenient way of storing Query commands for repeated use without having to retype them. Each procedure file can contain only one Query command that will be executed when the file is invoked. There are three types of procedure files used in Query: FIND procedure; REPORT procedure; UPDATE procedure. For example, rather than entering the REPORT command and its various statements every time a particular report is desired, a procedure file can be created to generate the report whenever needed. Procedure files are created within Query using the CREATE, DISPLAY, EXECUTE, and DESTROY commands.

Query command files can also be used to automatically execute Query commands. Query command files differ from procedure files in that they may contain several Query commands. For example, a Query command file can be created to open DBAT database, perform a FIND command, generate a listing of the data using the REPORT command, and close the database. Query command files are created using the HP1000's standard text editor.

3.3.5.3 IMAGE/1000 Software Storage Locations

The DBAT Database and all Query command and procedure files are stored on LU16. LU16 is configured as a File Manger storage device. The source software for the IMAGE/1000 System resides on LU3 in directory /SOFTWARE/IMAGE1_50. The execuable programs for the IMAGE/1000 System resides on LU3 in directory /PROGRAMS.

3.3.5.4 Query Command and Procedure Files

There are several Query command files and procedure files that have been developed for generating various battery data printouts. These files provide an automated method of generating reports from battery data contained within the DBAT Database. There are basically three steps involved in this type of task. First, a CI command file containing the selected print parameters is executed. This command file configures a Query command file and a REPORT procedure file, then executes Query based on the Query command file. The Query command file opens the DBAT Database, executes a FIND command on the print parameters, and invokes the REPORT procedure file. The REPORT procedure file selects the output device and generates the printout based on the results from the FIND command.

The following example lists these files and their contents.

CI Command File:

```
IF IS $3 EQ ''
    THEN
    SET LASTCYC = 1000
ELSE
    SET LAST CYC = $3
FI
RU.EDIT.Query command file name.9
    |P/////1/6|P XXXXXXXXX |6|P S1"|7|P XXXXXXX |7|P S2"|ER
RU.EDIT.Query command file
  name.8|P XXXXXXXXXXX |5|P SLASTCYC"|ER
RU,EDIT,Query command file name,10|P///////////////1/|ER
RU,EDIT, procedure name,6 |P/////////////////////**********///////|ER
RU,EDIT, procedure name.6 |P/////////////////////S1///////////|ER
RU,EDIT,  procedure name,4 |P/////////////////////////////////////////////1////|ER
RU,QUERY::PROGRAMS,Query command file name,1,1
```

Example Query Command File:

```
DATA-BASE=DBAT:2525:16;
SECUR;
1;
SELECT-FILE=SELDB::16;
FIND CDATA.ID# IS "" AND CDATA.CYC# IGT "" END;
"";
XXXXX;
LIST=1;
REPORT NAME= procedure file name;
EXIT;
```

Example REPORT Procedure File:

```
REPORT;
H1,"PAGE #",7;
H1,PAGENO,10;
H1,"DATA SUMMARY REPORT FROM HP 1000 QUERY:CYCLE
   SET #1",63;
H1,DATE,79;
H2,"*** BATTERY ID#XXX ******",50;
H2,TIME,79;
H3,"CYCLE DATE",13;
H3," TIME AHREM AHRET EODV",49;
H3," EODC EODT",64;
H3," EOCV EOCC",79;
H4,"*******************",20;
H4,"*********************************************",64;
H4,"****************",80;
S,CYC#;
D1,CYC#,6;
D1,DATE,13;
D1,TIME,26;
D1,AHREM,39;
D1,AHRET,47;
D1,EODV,54;
D1,EODC,62;
D1,EODT,69;
D1,EOCV,75;
D1,EOCC,83;
TF,AHREM,39,ADD;
TF,AHRET,47,ADD;
END;
```

There are many of these type of files that have been developed to generate various combination of battery data listings. All these types of files are saved in directory ::16.

3.3.5.5 Access DBAT Database through Applications

The data contained within the DBAT Image Database can also be accessed through the use of application programs. Programs written in FORTRAN can gain access to the database through program calls to the IMAGE library subroutines. There are 10 callable subroutines available to programs. They are as follows:

DBOPN — Initiates access to the database and defines the user's level of access

DBINF — Provides information about the organization and components of the database being accessed

DBFND — Locates the beginning of a data chain in preparation for access to entries in the chain

DBGET — Reads data items

DBUPD — Modifies the value of data items in existing data records

DBPUT — Adds new data records to database

DBDEL — Deletes existing data records from database

DBLCK — Locks a database temporarily to provide exclusive access

DBUNL — Unlocks a database previously locked by a call to DBLCK

DBCLS — Closes the database.

For more information about IMAGE calls refer to the IMAGE/1000 Reference Manual, Chapter 4.

3.4 Database Update Program DATR3

DATR3 is a software program that transfers battery test data from the RDATA.DAT file to the DBAT Image Database system and the MAJR.DAT file. DATR3 is written in FORTRAN 77 and resides in the central computer system in the /OPERATIONS directory. Figure 21 contains a simplified flowchart drawing of the DATR3 program.

DATR3's software contains three sections of code. In the first section, DATR3 creates a scratch file called RTEMPA.DAT and transfers all battery test data from the RDATA.DAT to it. The RDATA.DAT file is then reinitialized with zero values, and the fill pointer in the accounting record (record 1) is set to 1. The contents of the RTEMPA.DAT file is then sorted by ID#, Date, and Time entries.

In the second section of software code, the sorted data contained in the RTEMPA.DAT file is copied to the MAJR2.DAT file. The copy operation is acomplished by sequentially reading each record in the RTEMPA.DAT file and saving the record in its assigned data block within the MAJR2.DAT file. Assigned data block are based on battery ID#s. An in-depth discussion on the internal layout of the MAJR2.DAT data file and this transfer operation are covered in Paragraph 3.4.1 of this section.

In the third section of software code, the DBAT Image Database is opened, and selected data records from within the RTEMPA.DAT file are placed in the DBAT Image Database. Paragraph 3.4.2 discusses this process in depth.

3.4.1 MAJR2.DAT File and the Transfer Operation

MAJR2.DAT data file contains all battery test data generated by the testing process within the Battery Test Facility. This file is located in directory /MAJR on LU4 of the central computer system. The file is capable of containing 1,198,441 records of battery data. At present, only 73,000 records of battery data are contained within the file.

MAJR2.DAT is divided into 100 record blocks. For example, records 1 through 100, 101 through 200. The 100th record of each 100 record block contains a record number pointing to next 100 record block where the data continues.

Data for each battery ID# is contained within these 100 record blocks.

The data transfer process from RTEMPA.DAT into MAJR2.DAT utilizes the ACNT.DAT file. The ACNT.DAT file contains the start and end record locations for each battery contained within the MAJR2.DAT file. ACNT.DAT file can contain entries for up to 988 batteries.

When a record of data is read from the TEMPA.DAT file, DATR3 searches the ACNT.DAT file for an entry corresponding to this record's battery ID#. When one is found, the data record is saved in the MAJR2.DAT file at this record location. The End record pointer is then incremented by 1. If the value of this record pointer is equally divisible by 100, then DATR3 will search for the next available 100 record block. When one is found, the value of this record location is saved the previous block's 100th record location. DATR3 then updates the ACNT.DAT with the next available storeage location.

The next record is then read from the TEMPA.DAT file and the process continues all over again. When the last record of data is saved, both the ACNT.DAT and the MAJR2.DAT file is closed.

3.4.2 Transferring Data into DBAT Database

The transfer process between the TEMPA.DAT file, the DBAT Database, involves generating database records based on the structure of the DBAT's detail data sets. The generation of these records involves using the battery test flags contained in each record of battery data. All detail data sets are assigned certain battery test flags. Through the use of these test flags, DATR3 can determine which data items to select to generate the database records.

To generate CDATA and CELL database records, DATR3 uses .03, .09, .12, .13, and .14 test flags. Database records are saved in DBAT when a .12, .13, or .14 test flag is read. SUM database records use the same test flag assign-

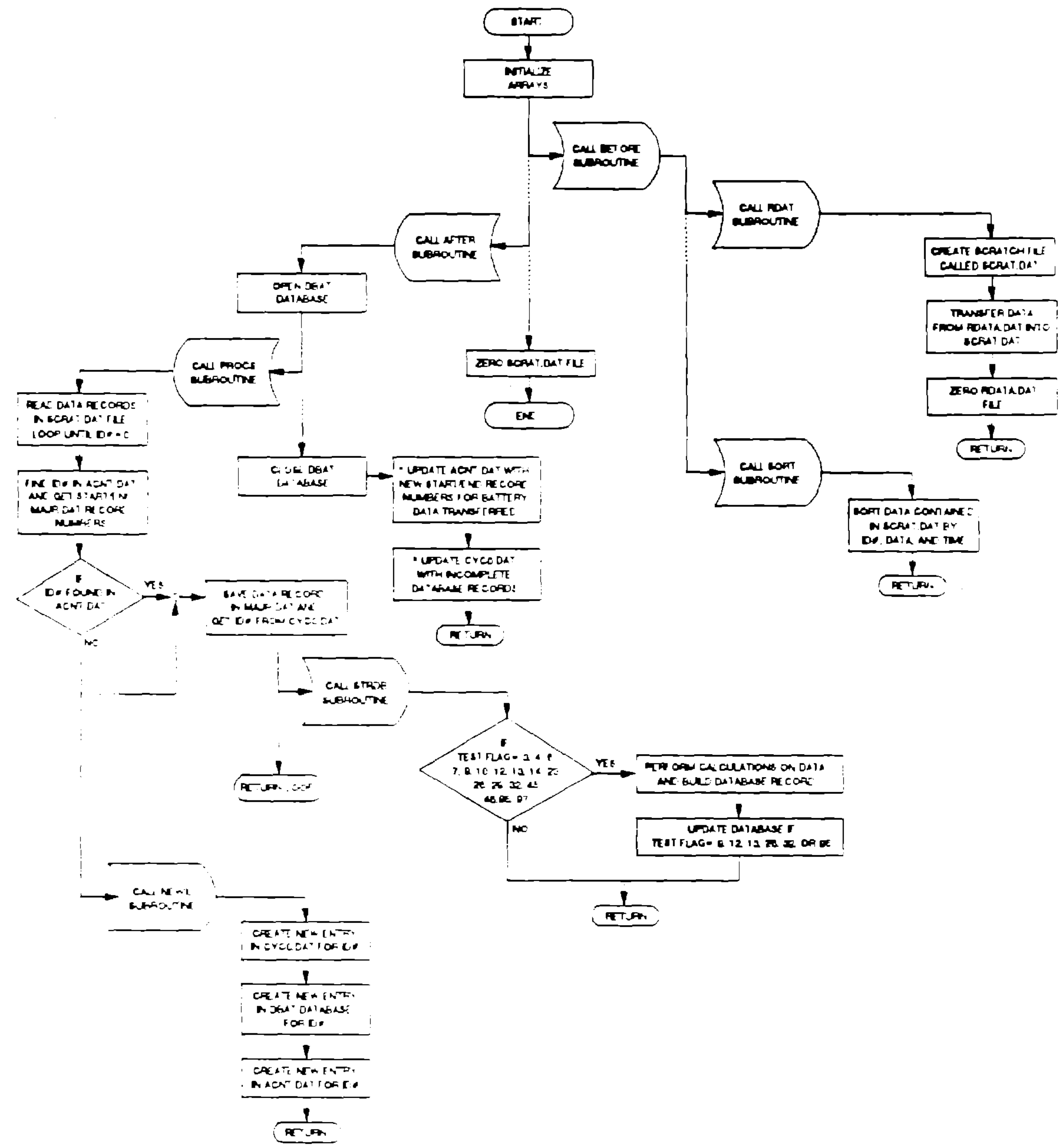


Figure 21. Flowchart of DATR3 Program

ments as stated above, but saves a record when a .13 or .14 test flag is read.

To generate CAP database records, DATR3 uses .26 and .32 test flags. A CAP database record is saved when a .32 test flag is read or if a test flag less of than .20 proceeds a test flag greater than 20. CYCO.DAT is a data file used by DATR3 during the generation of database records. The file contains partially constructed database records for each battery acquired during the last execution of DATR3. This file is located in the /OPERATIONS directory.

The transfer operation begins when DATR3 reads the first record of data from TEMPA.DAT. DATR3 then scans the CYCO.DAT file for an entry that matches the record's battery ID#. The selected data entry's record is combined with the present data record from TEMPA.DAT to produce a continuation of the database record. This keeps continuity between executions of DATR3. This process only occurs when there is a change in a data record's ID# or on the first TEMPA.DAT data record.

When a database record gets placed into the DBAT Database, the battery ID#'s corresponding CYC0 record gets zeroed. When a change in battery ID# is sensed, the previous battery ID#'s CYC0 record gets updated in the CYC0.DAT file.

3.4.3 Executing DATR3

To run the DATR3 program, you must be in the /OPERATIONS directory. If not, enter the following command:

CI > **WD /OPERATIONS**

To invoke DATR3 enter DATR3. Table 8 lists the output generated by DATR3 during its execution.

3.5 NPLOT Program

NPLOT software program is a utility used to list battery test data and create graphs from test data contained within MAJR2.DAT file. NPLOT is located in the /OPERATIONS directory. Figure 22 contains a flowchart diagram of the NPLOT program.

3.5.1 NPLOT Operational Procedures

3.5.1.1 Running NPLOT Program

To invoke this program, execute the command NPLOT at the CI prompt. Once running, NPLOT asks the operator to confirm that MAJR2.DAT and ACNT2.DAT are the data files to be used during this session. These questions appear as follows:

The default data files to be used are MAJR2.DAT and ACNT2.DAT

Do you wish to change these file names (Y or N)?

This question allows the operator to change the default file setting. If Y is entered, the following question is asked:

Enter the names of the new files to be used: (Example MJR437.DAT, ACNT437.DAT)

Enter the names of the new MAJR and ACNT files to be used during this session. Separate the file names with a space.

Once the operator has confirmed the MAJR and ACNT files, NPLOT displays its main display menu. Through this menu all NPLOT's functions are selected. These options are selected through the use of special function key assignments. These key assignments are as follows.

f1 = "Display Chg Time"	This option displays the lengths of selected charge periods.
f5 = "Search ID#"	This option creates a data buffer containing the results from the search expression.
f6 = "List ACNT"	This option lists the contents of the ACNT file.
f7 = "Chart Data Flow"	This option creates a list of all data blocks within the MAJR file, where the selected battery's data resides.
f8 = "Exit"	Terminates NPLOT

The following are procedures outlining the use of each special function key assignment.

Procedure 1. Finding Charge Period Lengths (Display Charge Time)

The Display Charge Time function is used to find and display the charge period lengths of any battery cycle contained within the MAJR file. To initiate this process, press the f1 key. NPLOT will respond by asking the following set of questions:

Enter ID# of data to be searched?

Enter cycle number of charge period to be displayed:

Answer the question by first entering the battery ID# of the data to be searched in MAJR file. Second, enter the cycle number of charge period length to be displayed. Once both questions are answered, NPLOT checks both entries for a valid response. If they are found to be invalid, the questions are re-asked.

NPLOT now searches the MAJR file for the cycle number. When found, calculate the charge period length based on the .10 and .12 test flag entries. Then, the following is displayed:

Battery# : xxx Cycle Number: xxx
Time On Charge Period (hours): xxxx

If the cycle number is not found, NPLOT displays the following:

!!Sorry, no data found for the search parameters given!!

NPLOT then returns to the main display menu.

Procedure 2. Generate a Temporary Data File (Search ID#)

The Search ID# function creates a data buffer containing the results obtained for the search expression. This data buffer containing battery test data results is then used in creating data lists and graphs. The search process starts out by NPLOT asking the following set of questions.

Table 8. Output Generated by DATR3 Program

```
DATR3 Database Transfer Program
ISTATUS= 1
ISTATUS= -2
NUMREC= 664
Building Scratch File From RDATA.DAT
RDATA.DAT File Has Been Zeroed!!
ISTATUS= 1
Performing Sort on 663 Records
Finished Sort, Start Write To TEMPA.DAT
NUMREC= 664
TEMPA.DAT After Sort

Store In Database:  ID=507  Flag=.12 CYC#= 99  Date= 4011.00
Store In Database:  ID=507  Flag=.04 CYC#= 100  Date= 4011.00
Store In Database:  ID=507  Flag=.06 CYC#= 100  Date= 4011.00
Store In Database:  ID=507  Flag=.07 CYC#= 100  Date= 4011.00
Store In Database:  ID=507  Flag=.09 CYC#= 100  Date= 4011.00
Store In Database:  ID=507  Flag=.04 CYC#= 100  Date= 4011.00
Store In Database:  ID=507  Flag=.06 CYC#= 100  Date= 4011.00
Store In Database:  ID=507  Flag=.10 CYC#= 100  Date= 4011.00
Store In Database:  ID=507  Flag=.12 CYC#= 100  Date= 4011.00
ACNT File  507   6928   1   7273   37
Put In CYC0 File, CYCB  507  .12  100.0  4011.0  65414.0
Store In Database:  ID=511  Flag=.06 CYC#= 34  Date= 4011.00
Store In Database:  ID=511  Flag=.04 CYC#= 34  Date= 4011.00
Store In Database:  ID=511  Flag=.06 CYC#= 34  Date= 4011.00
Store In Database:  ID=511  Flag=.07 CYC#= 34  Date= 4011.00
Store In Database:  ID=511  Flag=.09 CYC#= 34  Date= 4011.00
Store In Database:  ID=511  Flag=.04 CYC#= 34  Date= 4011.00
Store In Database:  ID=511  Flag=.06 CYC#= 34  Date= 4011.00
Store In Database:  ID=511  Flag=.04 CYC#= 34  Date= 4011.00
Store In Database:  ID=511  Flag=.06 CYC#= 34  Date= 4011.00
Store In Database:  ID=511  Flag=.10 CYC#= 34  Date= 4011.00
Store In Database:  ID=511  Flag=.12 CYC#= 34  Date= 4011.00
Store In Database:  ID=511  Flag=.04 CYC#= 35  Date= 4011.00
Store In Database:  ID=511  Flag=.06 CYC#= 35  Date= 4011.00
ACNT File   511   6821   1   7276   98
Put In CYC0 File, CYCB  511  .06  35.0  4011.0  75414.0
Store In Database:  ID=515  Flag=.13 CYC#= 26  Date= 4011.00
ACNT File 515 7087 1 7262 64
Put In CYC0 File, CYCB 515 .13 26.0 4011.0 65414.0

Program DATR3 Run. 663 Records Processed
Sorted RTEMPA.DAT File Has Been Zeroed!!
At Time= 8:40 AM MON., 7 JAN., 1991
```

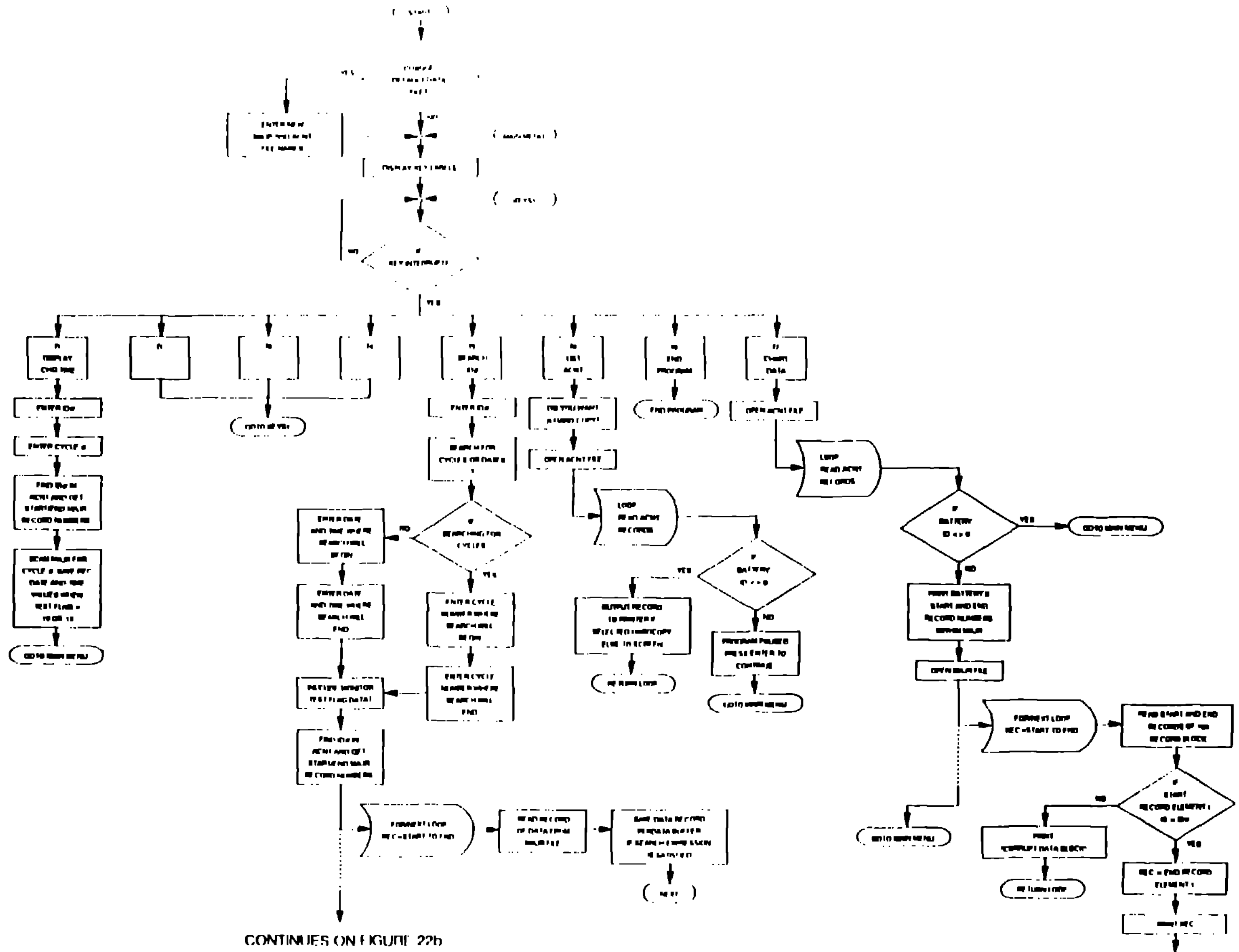


Figure 22a. Flowchart of NPLOT Program

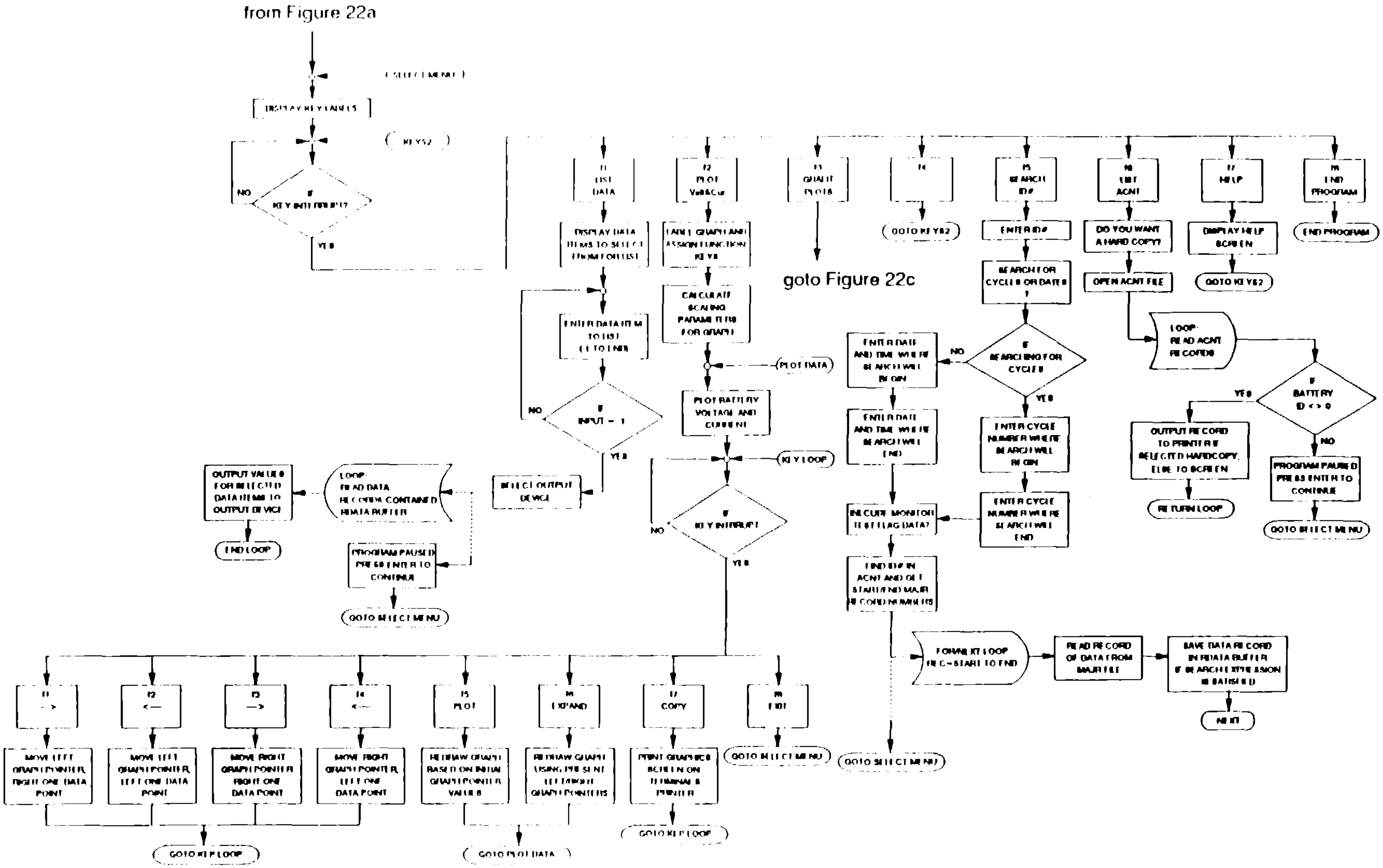


Figure 22b. Flowchart of NPLOT Program (continued)

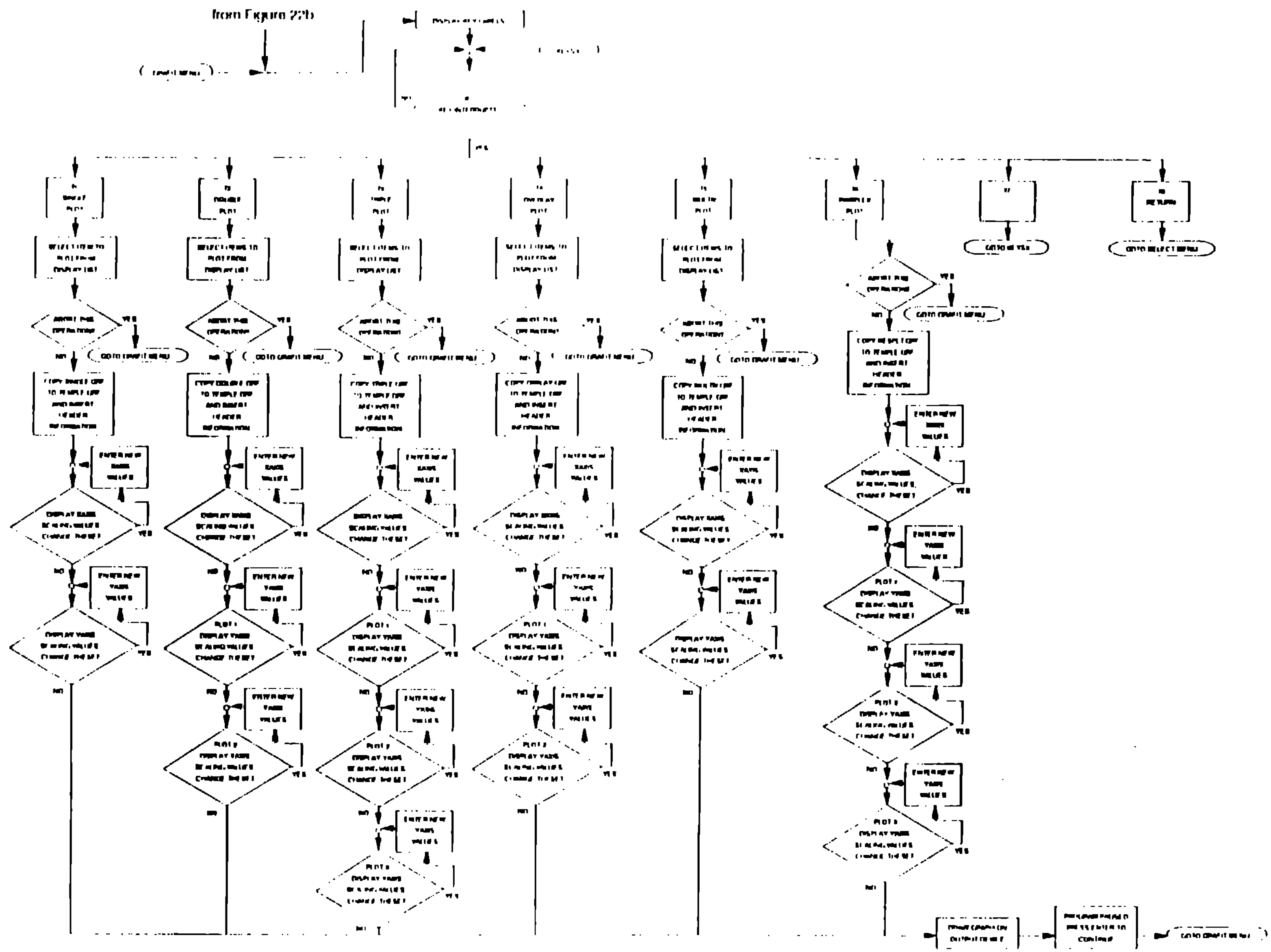


Figure 22c. Flowchart of NPLOT Program (continued)

Enter ID# of data to be searched:

Would you like to search for cycle numbers or dates? (enter CYCLE or DATE)

If CYCLE data searches are selected, the following questions are asked.

Enter cycle number where the data search will begin:

Enter cycle number where the data search will end:

If DATE data searches are selected, the following questions are asked:

Enter the start date and time where the data search will begin:

Enter the ending date and time where the data search will end:

Once entering a battery ID# and selecting the type of search to be conducted, NPLOT asks the following:

Do you wish to include MONITOR test flag in this search (Y or N)?

If N is entered, all data records that qualify the search expression but have .60 test flags, will not be included in the data buffer. This question is asked, due to some instances where a battery could generate many data records while not under test. For example, answer N to this question if the following conditions exist.

(1) There are many MONITOR test flags (.60) and its data is not needed.

(2) There are MONITOR test flags (.60) that span several days, and by including them, could create odd graphs.

(3) The search was previously tried, resulting in the data buffer being filled up. Selecting N will cut down the number of data records saved in the data buffer.

After selecting whether or not to include MONITOR test flags, NPLOT checks each parameter entered above for valid response. If one is found to be invalid, all previous questions will be re-asked.

NPLOT now opens the ACNT file and retrieves the first record number within the MAJR data file where this data begins. The MAJR is then opened and all preceding data records are scanned. Those that satisfy the search expression are copied into the data buffer. Once all records are scanned, a new menu appears. This menu is referred to as the First Display Menu. This menu contains a new set of special function key assignments. The following lists those key assignments.

f1 = "List data"	Creates battery data listings from the contents of the data buffer.
f2 = "Plot Volt&Cur"	Creates a graph which plots battery voltage and current from the data contained in the data buffer.
f3 = "Grafit plots"	Creates various types of graphs using the GRAFIT Software Package.
f5 = "New search"	A new search expression can be entered and new data buffer constructed.
f6 = "List ACNT"	Lists the contents of ACNT file.
f7= "Help"	Lists each special function key assignment used in this menu.
f8 = "End Program"	Terminates NPLOT

The following procedures outline the steps used in preforming the functions listed above.

Procedure 2.1 Generating Battery Data Listings (List Data)

When selecting this key, NPLOT creates a screen that looks similar to Table 9. This table lists the contents of each data element within a data record. Associated with each data item is the number of spaces used by the element when printed. As data items are selected, NPLOT sums the total number of print spaces used. This value is used to determine the type of print mode to select in the following step.

Select items by entering the code number of the data element you wish printed. Press the ENTER key after entering each item.

Continue selecting all the data elements you wish printed. Once you've selected all your choices, type -1 to end input. NPLOT will then ask you to select an output device. The prompt appears as follows:

Select the Output Device

1 - To generate listing on display terminal.

2 - To generate listing on system line printer in normal print mode.

3 - To generate listing on system line printer in compress print mode.

Enter number of output device:

Select a print method. Note that when listing the data to the display terminal, NPLOT will pause every 22 lines.

Table 9. List Battery Data Screen

Code	Data Item (space)	Code	Data Item (space)
1	Battery ID# (8)	9	Whrs Returned (10)
2	Date (7)	10	Voltage Monitor 1 (8)
3	Time (7)	11	Voltage Monitor 2 (8)
4	Battery Voltage (9)	12	Voltage Monitor 3 (8)
5	Battery Current (9)	13	Voltage Monitor 4 (8)
6	Ahrs Removed (10)	14	Voltage Monitor 5 (8)
7	Whrs Removed (10)	15	Voltage Monitor 6 (8)
8	Ahrs Returned (10)	16	Battery Temp. (8)
		17	Cycle Number (5)
		18	MAJR Record Number (7)

Enter Code numbers of the data items you wish listed.

NOTE: In normal print mode there are 80 characters across a page. In compress print there are 106 characters across a page.

Total characters in line: XX

Enter Code number of data item you wish listed (-1 to end):

You may abort the operation at this time by entering A. After the listing is complete, NPLOT returns to the First Display Menu.

Procedure 2.2 Displaying the Voltage and Current Graph (Plot Volt&Cur)

When you select the Plot Volt&Cur option, NPLOT creates a graph that plots battery voltage and current. The graph is drawn on the screen. This screen looks similar to that shown in Figure 23.

Associated with this screen are special function key assignments. The following outlines the functions of each key assignment.

f1 = "→"	Moves left expand pointer to the left one data point.
f2 = "←"	Moves left expand pointer to the right one data point.
f3 = "→"	Moves right expand pointer to the left one data point.
f4 = "←"	Moves right expand pointer to the right one data point.
f5 = "PLOT"	Redraws graph original graph.
f6 = "EXPAND"	Redraws graph with data contained between left and right pointers.
f7 = "COPY"	Generates a hard copy of the graph on the terminal default printer.
f8 = "EXIT"	Terminates PLTR48 and turns to CONFIG.

Through the use of special function keys f1-f4, and f6, portions of the graph can be selected and expanded. When either expand pointers is selected, a "V" appears on the graph. There are left and right expand pointers. The "V" points to actual data points on the graph. Once the pointers are moved to the portion of the graph to be expanded, press the EXPAND key (f6). This redraws the graph based on the data contained between the two pointers.

Another function of the expand operation is to select a portion of the plot to be used in the GRAFIT plotting routines covered in Procedure 2.3 of this section.

To return to the original graph, press the PLOT key (f5). A hard copy of the graph appearing on the screen can be obtained by pressing the COPY key (f7).

Procedure 2.3 Generating Plots with GRAFIT Utilities (Grafit Plots)

Through the Grafit Plots function, graphs are created using GRAPHICUS's Grafit Software Package. Grafit is a technically oriented graph generation package that enables a wide variety of graphs to be designed. The graphs that are produced through Grafit are high quality and suitable for technical publications and formal presentations. For a complete overview on the features and capabilities of the Grafit Software Package, refer to the GRAFIT USER'S GUIDE.

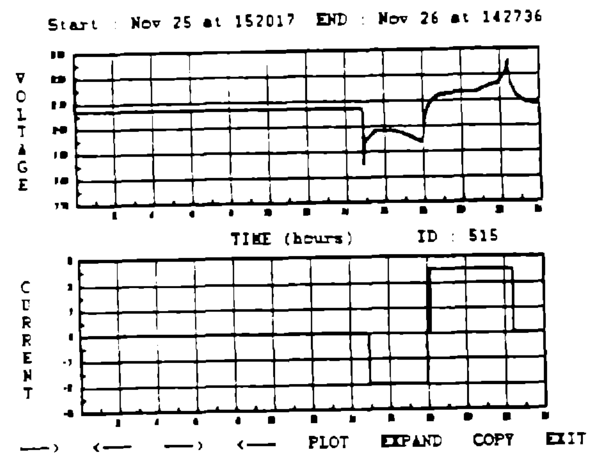


Figure 23. Plot Volt&Cur Screen

The software for the Grafit resides in /GRAPHICUS directory and is very large, spanning many levels of subdirectories. There are several predefined Grafit command files that NPLOT uses. They are all contained in the /GRAPHICUS/GRAFIT/COM/USER_DATA directory. These command files contain logically ordered Grafit commands used in producing a variety of graphs. Data is imported to these command files through the GRAPH_REAL.DATA file. This file is created by NPLOT whenever a Grafit plot option is selected.

When selecting Grafit Plots, a new key menu is displayed. This menu is referred to as the Second Display Menu. The following special function key assignments are associated with this menu.

f1 = "Single Plot"	Plots a single data element on a graph.
f2 = "Double Plot"	Creates two graphs on a page.
f3 = "Triple Plot"	Creates three graphs on a page.
f4 = "Overlay Plot"	Creates a graph that plots two data elements on different Y-axis.
f5 = "MultiV Plot"	Creates a graph that plots multiple data elements on a single Y-axis.
f6 = "Pwrplex Plot"	Creates a Powerplex graph.
f8 = "Return"	Returns to previous key menu.

Procedure 2.3.1 Creating Single Variable Plots Using Grafit

This option creates a graph that plots a single data element. Through this operation, NPLOT will create a data file called GRAPH_REAL.DATA that will be used to interface with the Grafit command files. Grafit command files or template files contain all the Grafit commands used in creating the various graphs. NPLOT modifies these template files to contain the parameters entered in this procedure.

This procedure starts out by listing all data variables available for the graph. This list is shown in Table 10. NPLOT then asks the following:

Enter Code number of the data item you wish plotted:

Select the code number of the data item to be plotted from the list shown on the screen. After this is entered, NPLOT then asks the following question:

Is this a CELL or a BATTERY you are plotting?

Answer this by indicating the type of battery module the selected data item was generated from. Enter CELL if this data measurement is to be made on a single cell battery or enter BATTERY if made on a multiple cell battery. Next, the following is asked:

Would you like to generate the graph using the 9872B Plotter?

Enter Y if the HP9872B plotter will be used to generate the graph or N if to be created on the CRT. NPLOT then gives you the option of aborting this procedure. If Y is answered, NPLOT returns to the previous display menu. This question looks as follows:

Do you wish to abort this operation (Y or N)?

Table 10. Data Items from which to Select for Graphs

Code Number	Items that may be Plotted
1	Battery Voltage
2	Battery Current
3	Amphrs Removed
4	Amphrs Returned
5	Watthrs Removed
6	Watthrs Returned
7	Cell Voltage 1
8	Cell Voltage 2
9	Cell Voltage 3
10	Cell Voltage 4
11	Cell Voltage 5
12	Cell Voltage 6
13	Temperature 1
14	Temperature 2
15	Temperature 3
16	Temperature 4
17	Temperature 5
18	Temperature 6
19	Battery Temperature

NPLOT then creates the temporary data buffer to be used by the SINGLE.GRF command template and calculates the scaling parameters for the graph. NPLOT displays the X-axis scaling parameters first and asks the following:

X-axis Scaling Parameters:

Maximum Data Value: XXXX TMAX: XXXX
Minimum Data Value: XXXX TMIN: XXXX
(divisions) TDX: XX

Do you wish to change any of these parameters (Y or N)?

If you answer Y to this question, the following questions are asked.

Enter new value for TMAX:

Enter new value for TMIN:

Enter new value for TDX (divisions):

Enter your values for these parameters. NPLOT then displays the X-axis scaling parameters again so that you can verify your entries. If these values look okay, enter N. The Y-axis scaling parameters are displayed next as follows:

Y-axis Scaling Parameters:

Maximum Data Value: XXXX VMAX: XXXX
Minimum Data Value: XXXX VMIN: XXXX
(divisions) VDX: XX

Do you wish to change any of these parameters (Y or N)?

If you answer Y, the following questions are asked.

Enter new value for VMAX:

Enter new value for VMIN:

Enter new value for VDX (divisions):

Enter your values for these parameters. NPLOT then displays the Y-axis scaling parameters again so that you can verify your entries. If these values look okay, enter N.

At this point, NPLOT makes a copy of the SINGLE.GRF and calls it TEMPLE.GRF. NPLOT then modifies this file so that the parameters entered above can be added. This is accomplished by invoking the HP1000's line editor. After the TEMPLE.GRF file has been changed, NPLOT invokes the Grafit program and passes it to the TEMPLE.GRF file. Grafit creates the graph based on the commands contained within the TEMPLE.GRF file. After the completion of the graph, Grafit terminates and NPLOT erases the TEMPLE.GRF file. Then, if the graph was drawn on the CRT, NPLOT suspends. To continue, press the ENTER key. NPLOT then erases the TEMPLE.GRF file, and you are returned to the First Display Menu. Figure 24 illustrates the type of graph created using the Single Plot option.

Procedure 2.3.2 Creating Double Graphs with Grafit (Double Plot)

This option creates two graphs on a single page. Each graph contains a plot of a single data element. This procedure starts out by listing all data variables available for the graphs. This list is shown in Table 10.

Now, you are asked to select the code numbers of the data items to be plotted on the two graphs. The questions appear as follows:

Enter Code number of the data item you wish plotted on the first graph:

Enter Code number of the data item you wish plotted on the second graph:

From this point on, NPLOT executes similarly to the way it does when generating single variable plots as covered in the previous procedure. One additional set of questions are asked. It covers the Y-axis scaling parameters for graph 2. Figure 25 illustrates the type of graph created using the Double Plot option.

Procedure 2.3.3 Creating Triple Graphs with Grafit (Double Plot)

This option creates three graphs on a single page. Each graph contains a plot of a single data element. This procedure starts out by listing all data variables available for the graphs. This list is shown in Table 10.

You are then asked to select the code numbers of the data items to be plotted on the three graphs. The questions appear as follows:

Enter Code number of the data item you wish plotted on the first graph:

Enter Code number of the data item you wish plotted on the second graph:

Enter Code number of the data item you wish plotted on the third graph:

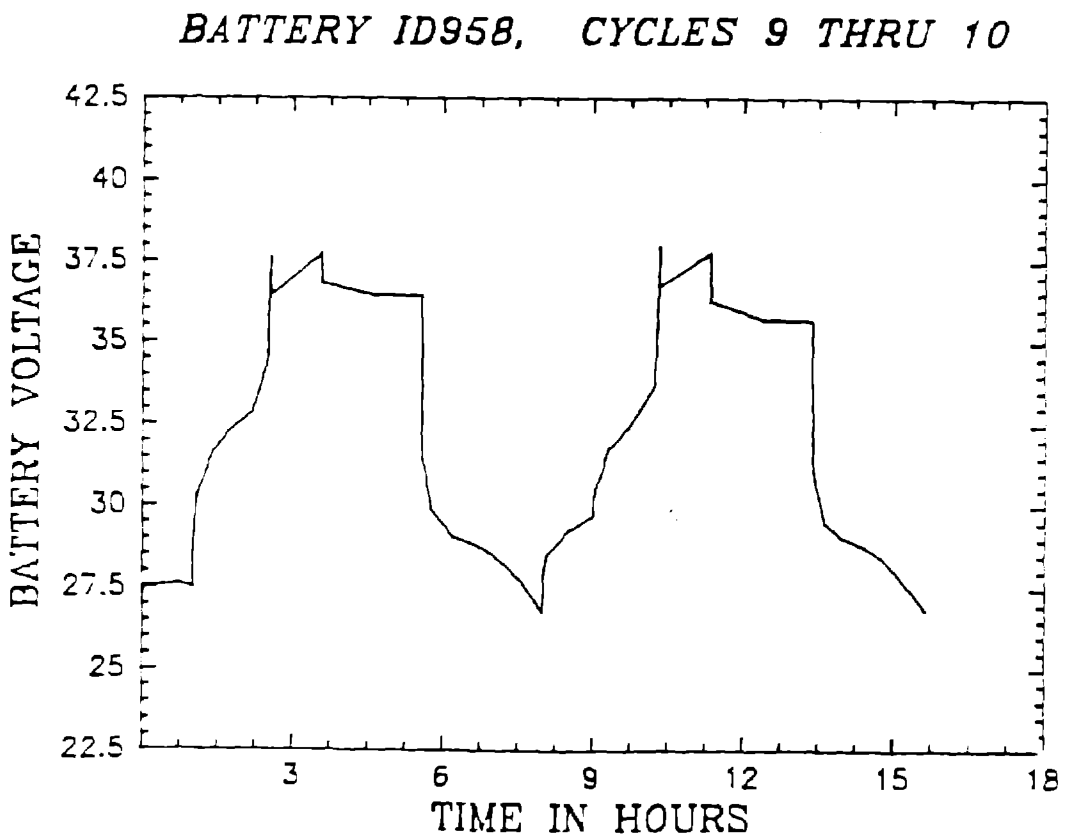


Figure 24. Single Plot Using Grafit

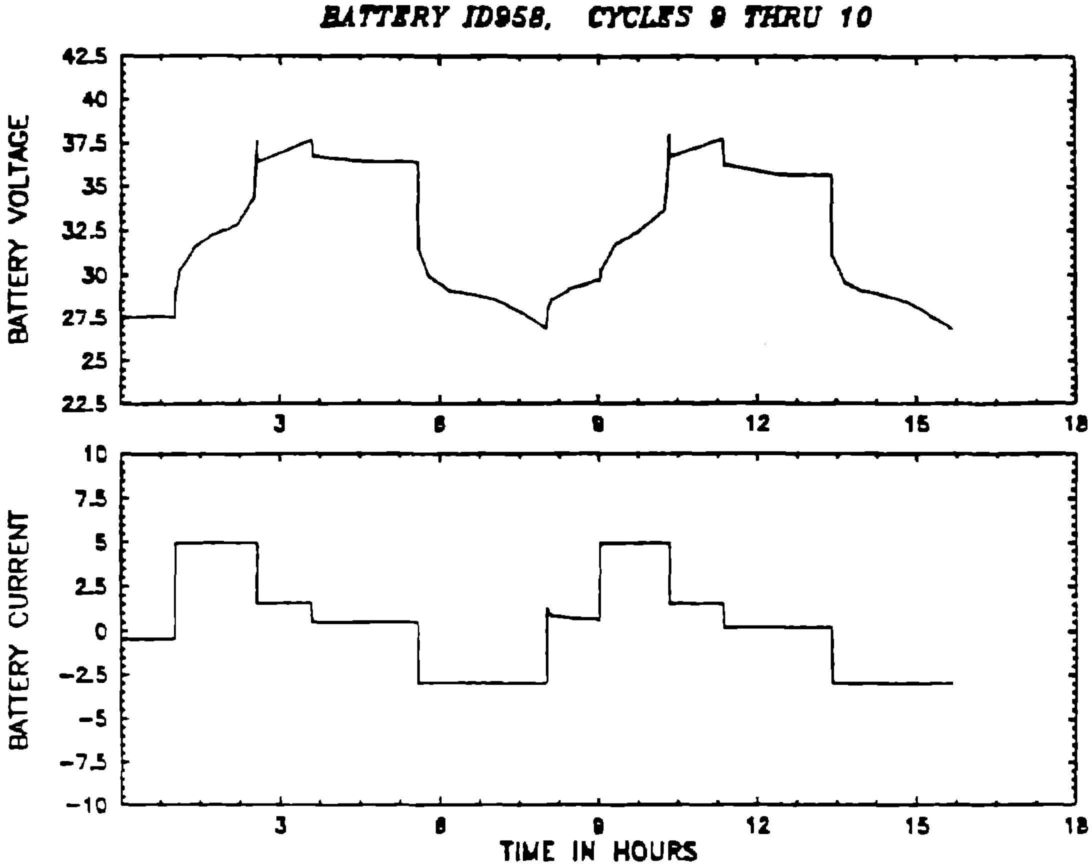


Figure 25. Double Plot Using Grafit

From this point on, NPLOT executes similarly to the way it does when generating single variable plots as covered in the previous procedure. There are two additional set of question that are asked. It covers the Y-axis scaling parameters for graph 2 and 3. Figure 26 illustrates the type of graph created using the Double Plot option.

Procedure 2.3.4 Creating Overlay Graphs with Grafit (Overlay Plot)

This option creates a single graph containing the plots of two data items. Each data item is plotted on its own set of Y-axis scale. The first data item is plotted on the Y-axis scale shown on the left Y-axis. The second data item is plotted on the Y-axis scale shown on the right Y-axis.

NPLOT starts out by displaying a table containing a list of data items to select for the graphs. This list is contained in Table 10. You are then asked to select the code numbers of the data items to be plotted. The questions appear as follows:

Enter Code number of the data item you wish plotted on the primary graph:

Enter Code number of the data item you wish plotted on the secondary graph:

From this point on, NPLOT executes similarly to the way it does when generating single variable plots as covered in the previous procedure. There is one additional set of questions that are asked. It covers the Y-axis scaling parameters for secondary graph. Figure 27 illustrates the type of graph created using the Overlay Plot option.

Procedure 2.3.5 Creating Multi-Variable Graphs with Grafit (Multi-V Plot)

This option creates a single graph containing the plots of several data items. All data items are plotted on the same Y-axis scale. This procedure starts out by listing all data variables available for the graphs. This list is shown in Table 10. You are then asked to select the code numbers of the data items to be plotted. The questions appear as follows:

Enter Code number of the data items you wish plotted (-1 to stop input):

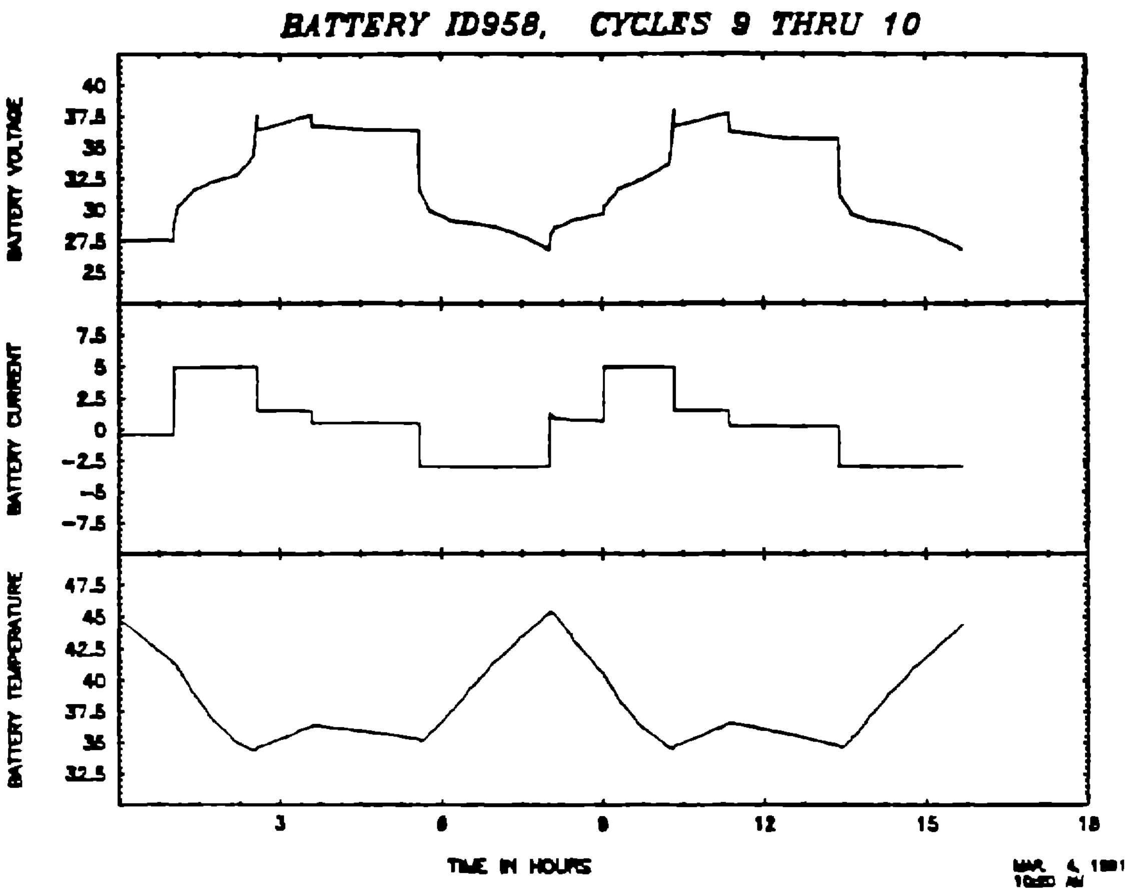


Figure 26. Triple Plot Using Grafit

Select all data items to plot and enter them one at a time. Enter -1 to end your list. Remember that all the data item you select will be plotted using the same Y-axis scale.

From this point on, NPLOT executes similar to that when generating single variable plots as covered in the previous procedure. Figure 28 illustrates the type of graph created using the Multi-Variable Plot option.

Procedure 2.3.6 Creating Powerplex Graph with Grafit (Pwrplex Plot)

This option creates a special graph designed by Powerplex which plots a battery's load voltage, open circuit voltage, resistance, and current on a single graph. This involves three different Y-axis scales. Battery voltage, loaded and open circuit, is plotted on one Y-axis, resistance values are plotted on another, and current values on another. This type of graph best describes the test results of Sodium/Sulfur type batteries.

NPLOT starts out by asking the following questions:

Is this a CELL or a Battery you wish plotted?

Will you be plotting to the 9872 plotter (Y or N)?

Do you wish to abort this operation (Y or N)?

All of these questions are similar to the others asked in the previous procedures. Likewise, this operation functions like the previous procedures with only a sight difference in Y-axis scaling questions.

You are first asked to verify the X-axis scaling values; then to verify the Y-axis scaling for the two voltages (loaded and open circuit); then to verify the Y-axis scaling for the resistance parameter; and then to verify the Y-axis scaling values for the current parameter. Figure 29 illustrates the type of graph created using the Multi-Variable Plot option.

3.6 DBPLOT Program

DBPLOT is a software program written to create various types of graphs from the data contained within the DBAT Image Database. This program was designed to be used in conjunction with one of several database command files such as CRT1. DBPLOT utilizes the results obtained through the DBFIND command.

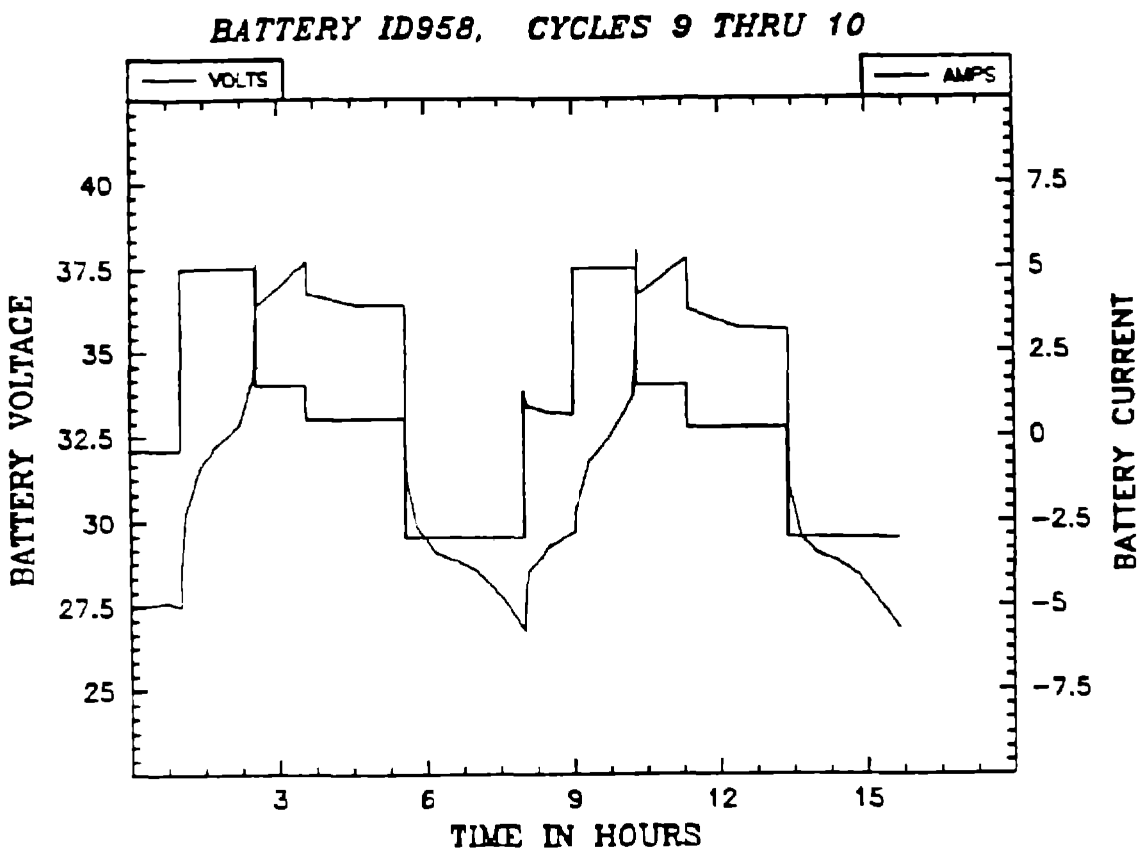


Figure 27. Overlay Plot Using Grafit

DBPLOT is made up of two programs. DBPLOT and PLTR1. DBPLOT is the main program where all graph parameters are set by the operator. PLTR1 contains the software utilities used in constructing the graphs. DBPLOT executes PLTR1 and suspends while the plot is being constructed. Both DBPLOT and PLTR1 reside in the \OPERATIONS directory.

3.6.1 Features of DBPLOT

DBPLOT is a very flexible graphic plotting utility, mainly due do its ability to plot data contained in the DBAT Database. This allows a graph to be created that can contain plots from several different batteries. Also, any combination of data items can be plotted on the same graph. DBPLOT has to ability to print a listing of the data values before plotting them. Graphs can be drawn on the CRT and on the 9872B plotter.

3.6.2 DBPLOT Operation

Before DBPLOT can be executed, a Query FIND command must be invoked. This can be done in one or two ways. The first, by executing any one of several database command files, such as CRT1. The second, by manually accessing the DBAT Image Database and generating a search expression using the Query FIND command.

After creating a search result by one of the methods described above, DBPLOT maybe executed. This is done by entering DBPLOT at the CI prompt.

When DBPLOT is executed, the first question it asks is as follows:

Have you created a file to be plotted using CRTX or PRINTX (Y or N)?

This question is asked to reaffirm that it has be done. Answer N if it has not been done, to which DBPLOT will terminate. If you answer with Y, DBPLOT will list the results of the search on the CRT. The display is as follows:

Battery Data Plotting Program

Data Set: CDATA Set Number: XX
Total size of search result: XX

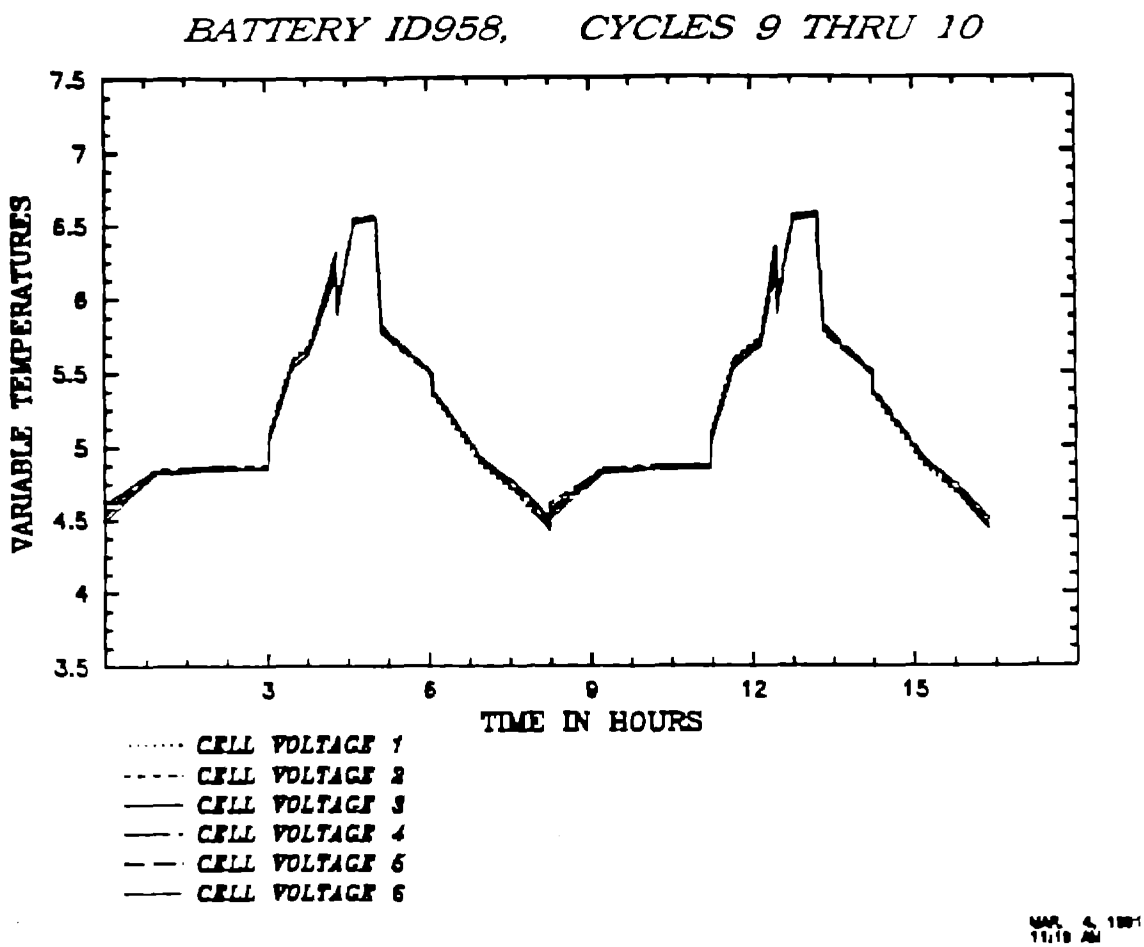


Figure 28. Multi-Variable Plot Using Grafit

Select desired item to be plotted vs cycle number from following list.

6 AHREM	**7 AHRET**
8 WHREM	**9 WHRET**
10 EODV	**11 EODC**
12 EODT	**13 EOCV**
14 EOCC	**15 EOCT**
16 EODAT	**17 EOCAT**
18 CYCTY	**19 VOLTAIC**
20 RTD#	**21 RTR#**
22 SDSGD	**23 EDSGD**
24 SCHGD	**25 SDSGT**
26 EDSGT	**27 SCHGT**
28 COULOMBIC	**29 ENERGY**

Do you want to plot data from more than one ID# (Y or N)?

If the search result contains data from multiple batteries, answer Y to this question. At which point DBPLOT will ask you to select a item to be plotted from the list above. Then you will be asked to enter the battery ID#s of the data contained in the search results.

If you answered N, you will be asked the following:

Do you want a multivariable plot (Y or N)?

If the search result contains data from multiple data items, enter Y to this question. You will then be asked to enter each item from the list above. Enter a 0 to end list.

You will now be asked the following:

Do you want a hardcopy listing of the data (Y or N)?

If you answer Y to this question, a copy of the data obtained through the search result will be printed on the system's line printer.

DBPLOT then displays the following:

Data Generated on: Jan. 3 1991 at 14:00:00 pm .

Variable #1: XXX (for multiple variable plots they'll be listed across here —)

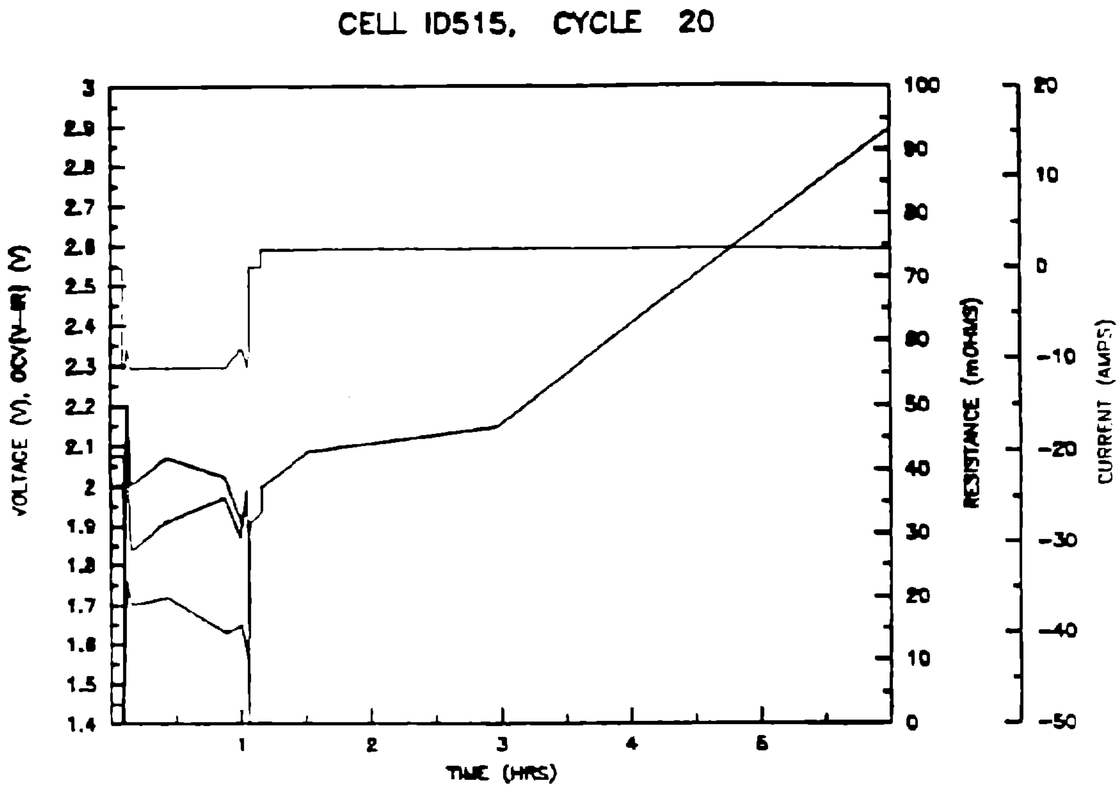


Figure 29. Powerplex Plot Using Grafit

Date	**Time**	**Cyc#**	**VAR#1**
(multiple variable items will be listed across here —)			
XXX	XXX	XXX	XXXXX
XXX	XXX	XXX	XXXXX
XXX	XXX	XXX	XXXXX
XXX	XXX	XXX	XXXXX

Do you want to transform a variable (Y or N)?

Answer Y to this question if you wish to change the values of a variable. If so, you will be asked to enter by what factor do you wish to change these values. Enter this factor. DBPLOT will then redisplay the screen shown above.

If you answered N, you'll be asked the following:

Do you wish to plot this data on the CRT (Y or N)?

If you answer this question N, you'll be asked the following:

Do you wish to plot this data on the 9872B (Y or N)?

Answer Y if the graph is to be generated there. DBPLOT then displays the scaling parameters for the graph and asks you the following.

Xmx Adjusted to allow for integer values on tic marks.
Xmin= XX Xmax= XXX
LO-Xaxis= XX HI-Xaxis TICDX= XX

Do you want to change these values (Y or N)?

If you wish to change any one to these scaling parameters, enter Y. DBPLOT will then ask the following set of questions:

Enter desired value for Lo-Xaxis:

Enter desired value for Hi-Xaxis:

Enter desired value for TIC value:

Once new values have been entered for each of these parameters, DBPLOT will relist the values as shown above.

DBPLOT now displays the values for the Y-axis scaling parameters. If you wish, change these values in the same manner.

After all scaling parameters have been selected, DBPLOT asks the following set of questions:

Y-axis label is: XXXX
Do you want to change the Y-axis label (Y or N)?

Do you want to graph capacity lines (Y or N)?

Do you want to connect data points (Y or N)?

If you answered Y to the first question, you will be asked to enter a new label. The second question, if answered Y, will indicate on the graph where, if any, capacity tests were executed. The third question, if answered Y, will draw lines connecting each data point on the graph.

DBPLOT is now finally ready to create the graph. If you choose the CRT as the plot device, the graph is drawn there. At the completion of the graph, press the RETURN key to continue. You will then be asked if you would like to create this plot on the 9872B plotter. If you select Y, the graph will be redrawn there.

At the completion of the drawing, DBPLOT will ask the following question.

Do you wish to plot more data from this search result (Y or N)?

If you answer Y, you will return to the screen that lists the data items. Answer N to this question to terminate DBPLOT.

3.7 Other Software Programs

3.7.1 CHANGR Software Program

The CHANGR program is used in modifying or deleting data element values within the MAJR file. This program resides in the \GUS\WORK directory.

3.7.2 OFFLD Software Program

The OFFLD Software Program is used to achieve old battery data on magnetic tape from the MAJR data file. Battery data is selected per ID# and contains XXXMJR.DAT and XXXACNT.DAT file names. As data is removed from the MAJR file, it is replaced with zeros. This frees up MAJR record locations for future use. Achieved files can be copied back into the system at any time and their data accessed through the use of the NPLOT program.

OFFLD also contains an import option. This option reads data records directly from an LU and places the data on to magnetic tape.

3.7.3 LISTR Software Program

The LISTR program is used to list the contents of the RDATA.DAT file on the CRT or line printer. Data can be listed in ascending or decreasing order.

3.7.4 SSERV Software Program

The SSERV program is used to process service request (SRQ) from the LUs. This program works in conjunction with any program that communicates with the LUs, such as IOPROG, FLOPY, UPDATE, and others.

When one of these programs enables an SRQ interrupt, the SSERV program monitors the SRQ line for responses. When an SRQ response is sensed, SSERV conducts a series poll of all devices on the HP-IB bus to determine the device that is reponding. When found, SSERV transfers this information back, through the IPRAM array, to the program that enabled the interrupt. Refer to the HP-IB Users Manual for a complete discussion on this process.

The SSERV program resides in the \GUS\WORK directory. This program is executed at BOOT time as a system utility.

3.7.5 NEWID Software Program

The NEWID program is used to generate a new entry in the DBAT Database when a new battery ID# is added to the test facility. This program creates an entry in the manual master data set for the new battery. The program resides in the \OPERATIONS directory.

3.7.6 DBCNT Software Program

The DBCNT program is used to remove unwanted data entries from the DBAT Database. When data entries are removed, DBCNT then renumbers all the data cycle for that battery. This program resides in the \OPERATIONS directory.

3.7.7 FIXCYC Software Program

The FIXCYC program is used to renumber a battery's test cycle numbers within the MAJR file. Test cycles are renumbered in accordance with the entries in the DBAT Database. This program resides in the \OPERATION directory.

3.7.8 DBUNL Software Program

The DBUNL program is used to remove old battery data entries from the DBAT Database. This program remove all the data that pertains to a selected battery from the database and places it the achieve database called DBOLD. The DBOLD Database resides on LU 18. The DBUNL program resides in the \OPERATIONS directory.

3.7.9 VWDATA Software Program

The VWDATA program is used in the HP9000 computers to list battery data records contained on a DATA DISC. This program resides in the portable Series 310 computer in the \PROGRAMS\GEN directory.

3.7.10 PWRPROFILE Software Program

The PWRPROFILE program is used by the HP9000 series computers to perform SFUDS test. This program resides in the portable Series 310 computer in the \PROGRAMS\BATT directory.

4.0 Basic Line Unit Operation

The HP9000 Series 310 computer, when executing the NEWBT program, acts as the test controller for the six test stations that make up a Line Unit (LU). NEWBT controls all battery test operations, like charge/discharge periods, connect/disconnect operations, and voltage, current, temperature measurements.

In a LU, the HP9122 Disc Drive and the HP3497A data acquisition/control unit share the same HP-IB bus. The bus has a select code of 8. The HP3497A has a bus address of 9 and the HP9122 a bus address of 0. The LU's printer is connected to a separate HP-IB bus at select code 10. The printer's HP-IB bus address is set at 01.

The HP3497A data acquisition/control unit performs three functions. First, it executes commands received from the test controller to control charge/discharge periods and connect/disconnect modes of battery test operations. Second, it performs test measurements of battery voltages, current, and temperatures. Third, it controls the testing current on all six test stations.

All voltage, current, and temperature lines are tied directly to each of the six test station patch panels. The charge/discharge, connect/disconnect operations are performed by dip relay closures in the HP3497A. The output of these relays are tied directly to the nine channel battery test control unit. Each of the six test stations has its own set of charge/discharge, connect/disconnect control lines. The relay closures in the HP3497A affect digital logic states in the nine channel control unit, which in turn control driver circuits. The outputs of these driver circuits are tied to their assigned channel within a dual channel relay chassis, which routes battery test currents.

Located in each of the Dual Channel Relay Chassis are large high current DC contactors. These contactors are used to route battery test currents from either the battery charging unit during charge periods, or to the Load unit during discharge periods. A battery can also be placed in an open circuit state (disconnect mode).

Each station's battery test current level can be controlled in one of two ways, manually (RELAY controlled) or remotely (D/A controlled). Under manual control, test currents are set by physically adjusting the current adjust knob on the battery charging unit and the load unit. Under remote control, NEWBT sets the test currents. Under this method of control, the software issues commands that control the output of a D/A card contained within the HP3497A. This D/A voltage output is then directed to either the battery charging unit during the charge period or the load unit during the discharge period. Figure 30 shows the wiring connections associated with this operation.

4.1 D/A Current Programming Calibration

The following procedure identifies the steps used to correctly calibrate a test station for remote current programming. This procedure calibrates the remote current programming option of the HP6268B and HP6260B DC Power supplies for use as a battery charger within the test facility. The procedure also lists changes to an Electronic Load unit so that its current output can be controlled.

Battery Charge Current Calibration

Equipment needed: two 4-1/2 digit voltmeters with clip leads, and a small jewelers type screwdriver.

(1) Attach one voltmeter across current channel of test station to be calibrated. Test station current channels are located in the rear of each LU rack, on the I/O patch panels. Current channels are as follows:

Channel Number	Test Station
1	1
9	2
17	3
25	4
33	5
41	6

(2) Attach other voltmeter to A5(+) and A4(-) of terminal strip on rear of power supply to be calibrated.

(3) Pause NEWBT battery test program if executing.

(4) Set current program output to zero. Do this by executing from the keyboard OUTPUT 709; command, where command is as follows:

Test Station	Command
1	"AO15,0,0"
2	"AO15,1,0"
3	"AO16,0,0"
4	"AO16,1,0"
5	"AO17,0,0"
6	"AO17,1,0"

(5) (Optional) Install a dummy battery at test station location to be calibrated.

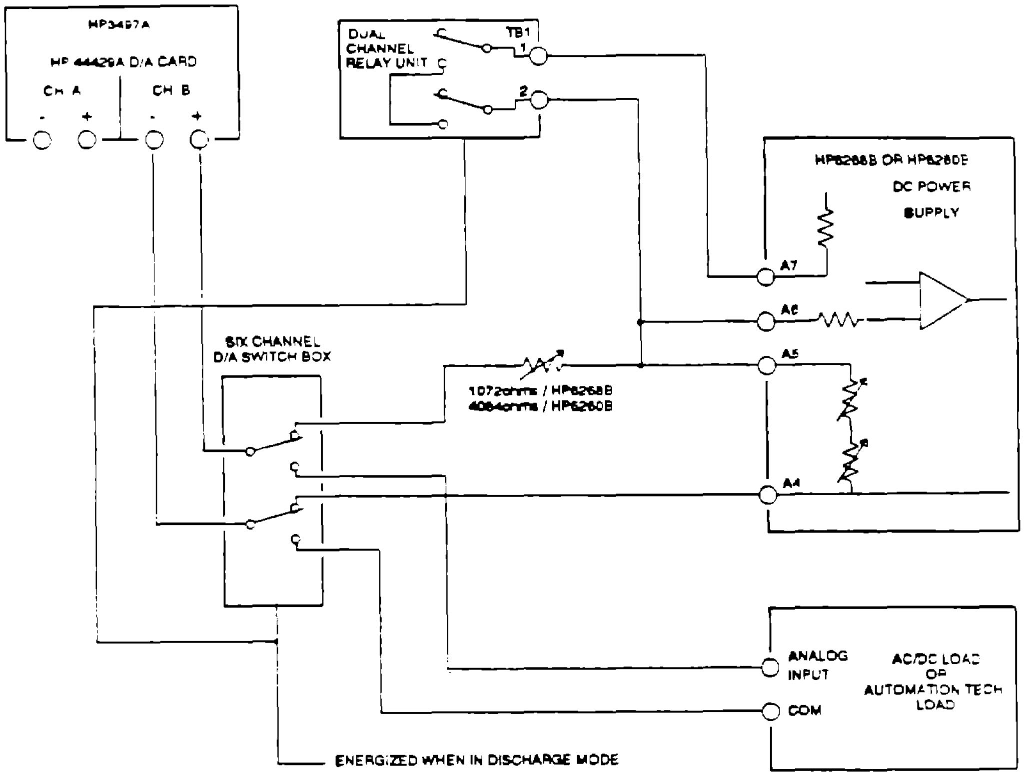


Figure 30. Remote D/A Current Control Configuration

(6) Turn power supply's two front panel current adjust knobs fully clockwise.

(7) Manually put test station in CHARGE mode and CONNECT position.

(8) Read current value on DVM 1 (off by factor of 1000). This value should be ~0 Volts. If not, adjust CURRENT ZERO and PROGRAM plots until a 0 voltage level is read.

(9) Put test station in DISCONNECT position.

(10) Output a current command of 1 Amp from the keyboard. For example, test station 1 would have a command as follows: OUTPUT 709;"AO,15,0,100". Refer to Step 4 for additional information.

(11) DVM 2 should be reading 16.7 mV if using a HP6268B power supply or 5.0 mV if using a HP6260B power supply. If not, adjust the external trimpot on the back of the power supply until this reading is obtained.

(12) Set current output command to zero (refer to Step 4).

(13) Put test station in CONNECT position. Check DVM 1 reading, it should read ~0 Volts. If not, repeat Steps 8 through 12.

(14) Output a current command of 1 Amp from the keyboard.

(15) DVM 1 should 1 Amp (.001 Volt); if it is, the charge current calibration is complete. If this reading is off by some small amount, adjust the power supply's CURRENT PROGRAM pot. But remember, this may affect the zero current setting.

Battery Discharge Current Calibration

AC/DC Electronic Load Unit

This unit provides no external calibration adjustments, though some units require an internal hardware modification. This modification entails replacing a resistor with one having a different resistance value. This will change the factory default current programming from 10 Volts/150 Amps to 10 Volts/100 Amps.

If your determine this modification does not exist, perform the following.

(1) Remove the unit's top cover.

(2) Remove the mother board from the unit. It is the PC board installed vertically just behind the front panel meters.

(3) Locate resistor R11, remove it, and insert a 150 Kohm, 1/4 Watt resistor in its place.

(4) Replace PC board. If you have time and wish to calibrate the unit even further, perform the following:

a. Attach a DC power supply (1) capable of providing a 10 Amp output (HP6268B) to the high current input terminals at the rear of the unit.

b. Attach a DC power supply (2) capable of providing a 1 Amp output to J2-1(-) and J2-7(+) to the J2 connector on the rear of the unit.

c. Turn AC power on to load unit by pressing green "PWR" switch. Press "I" in MODE, "OFF" in DYNAMIC LOADING, and "10A" in CURRENT RANGE.

d. Turn on power supply 1, rotate CURRENT adjust knobs fully clockwise, and set voltage output to 10 Volts.

e. Turn AC power on to power supply 2 and adjust its voltage output to 100 mV.

f. Read front panel current meter of power supply or load; it should read 1 Amp. If not, adjust trimpot R10 on the mother board until this level is obtained.

g. Turn AC power off to power supply 2, power supply 1, and load unit in this order.

h. Disconnect all leads and replace cover on Load unit.

Automation Technology Load Controller

For this unit to be compatible with existing D/A current programming configuration, its external current programming characteristics must be changed. This modification entails changing a resistance value that effectively changes the unit's factory default from 5 Volts/200 Amps to 10 Volts/100 Amps.

To install this modification, perform the following:

(1) Remove the unit's top cover.

(2) Remove the mother board from the unit. It is the PC board installed just behind the front panel meters.

(3) Locate resistor R18, remove it, and insert a 324 Kohm, 1/4 Watt resistor in its place.

(4) Replace the PC board. If you have time and wish to calibrate the unit even further, perform the following:

a. Attach a DC power supply (1) capable of providing a 10 Amp output (HP6268B) to the high current input terminals at the rear of the unit.

b. Attach a DC power supply (2) capable of providing a 1 Amp output to pin 1(-) and pin 7(+), of connector J1, located on the rear of the unit.

c. Turn AC power on to load unit using switch labeled "AC POWER." Put unit in "STAND BY," "CONSTANT CURRENT," and meter in "AMPS" mode. Switch on front panel circuit breaker.

d. Turn on power supply 1, rotate CURRENT adjust knobs fully clockwise, and set voltage output to 10 Volts.

e. Turn AC power on to power supply 2 and adjust its voltage output to 100 mV.

f. Read front panel current meter of power supply or load; it should read 1 Amp. If not, adjust the front panel calibration trimpot #1 until this level is obtained.

g. Turn AC power off to power supply 2, power supply 1, and load unit in this order.

h. Disconnect all leads and replace cover on Load unit.

4.2 Wiring Diagrams and Test Station Connector Pinouts

All wiring from the HP3497A data acquisition/control unit to the nine channel battery test control unit, dual channel relay chassis, and each test station patch panel, goes through a main terminal location. Also, all wiring from the nine channel battery test control unit to the dual channel current control unit, and the test station patch panels go through this same main terminal location. This was done so that each test station could be easily configured and it makes troubleshooting much easier. Refer to Drawing section for LU layout and electrical interconnects.

4.3 Line Unit Equipment Turn On/Off Procedures

4.3.1 Equipment Turn On Procedures

The following procedures assume all electrical equipment has its AC power switched off.

Powering Up a Line Unit

(1) Apply AC power to the LU's UPS system.

a. Insert AC power plug into a 120VAC 30 Amp receptacle (RTE Deltec UPS).

b. Switch INPUT circuit breaker to ON position (up).

c. Switch INVERTER circuit breaker to ON position (up).

d. After inverter turns on, you will hear it. Wait 30 seconds and toggle the TRANSFER SWITCH up and down, then up again.

(2) Switch on AC power to the computer equipment. This is accomplished through the back of the equipment rack. Inside the back of the rack is a TOPAZ power strip. Turn on AC power to this by pressing the red POWER switch. This will apply AC power to the HP9000 computer, HP monitor, HP9122 disc drive, HP-IB bus extender, and HP ThinkJet Printer.

(3) Turn on AC power to the DONNER DC Power Supply at the switch labeled POWER ON. This then applies 28 Volts to each of the relay control units.

(4) Turn on AC power to the six battery chargers. This is accomplished by switching the black circuit breaker labeled LINE to the ON position (up).

(5) Turn on AC power to the six load units.

a. ACDC Electronic Load Unit: AC power is turned on by pressing the green buttom labeled PWR on the left and right channels.

b. Automation Technology and Digitec Load Units: AC power is turned on at the switch labeled AC POWER. Also, put the black circuit breaker in the ON position (up), and the STANDBY/OPERATE switch, in the OPERATE mode (down).

(6) If the LU contains a water chiller, turn on AC power by placing the front panel toggle switch in the desired temperature range (switch up or down).

4.3.2 Equipment Shutdown Procedures

The following procedures assume all electrical equipment is on and operating normally and NEWBT software program has been halted.

Shutting Down a Line Unit

(1) If the LU contains a water chiller, turn off AC power by placing the front panel toggle switch in the center position.

(2) Turn off AC power to the six load units.

a. ACDC Electronic Load Unit: AC power is turned off by pressing the green bottom labeled PWR on the left and right channels.

b. Automation Technology and Digitec Load Units: AC power is turned off at the switch labeled AC POWER. Also, place the black circuit breaker in the OFF position (down), and the STANDBY/OPERATE switch, in the STANDBY mode (up).

Appendix A
Nine Channel Battery Test Control Unit

Appendix A
Nine Channel Battery Test Control Unit

The nine channel battery test control unit is a device that controls the hardware operation of the equipment used in performing battery tests. This unit can control the hardware operations of up to nine test stations. Control functions include switching test batteries between charge, discharge, short, and open circuit states. The unit also checks for high/low battery voltage levels, high test current levels, and for test controller (HP9000 or HP3497A), software lockup conditions. Refer to Drawing section for chassis layout and electrical schematic.

Each channel on the unit is individually controlled. The charge, discharge, short, and open circuit modes are controlled either locally (through use of the units front panel switches) or remotely (HP9000 computer). All test conditions for each channel on the unit are displayed by LED indicators.

Front Panel LED Indicators and Switch Settings

The following is a list of all LED indicators, switch settings, and trimpot adjustments located on front panel of the nine channel battery test control unit.

CONNECT LED: indicates when a battery under test is placed across either the charging power supply or the discharging electronic load unit.

DISCONNECT LED: indicates when a battery under test is in a high resistance (open circuit) state.

CONNECT/DISCONNECT switch located under the DISCONNECT label is used to manually switch a battery under test between a high resistance (open circuit) state or loaded state (charge or discharge mode).

RESET LED: indicates when a hardware alarm condition has been sensed.

RESET switch is located to the left of the RESET indicator and is used to enable test modes after a hardware alarm has been sensed.

REMOTE/CHARGE/DISCHARGE switch is located under the RESET switch. This switch is used to manually place an electronic load across the battery during the discharge switch setting (switch in the down position) or to place a power supply across the battery during the charge switch setting (switch in the middle position), or to transfer control of the charge/discharge connect/disconnect operation to the test controller during the remote switch setting (switch in the up position).

REMOTE indicator is used to display when test control has been transferred to the test controller.

CHARGE indicator is used to display when the battery has been placed across the power supply for a charge operation.

DISCHARGE indicator is used to display when the battery has been placed across the electronic load for a discharge operation.

SHORT indicator is used to display when a short circuit has been placed across the battery under test.

SHORT switch is located to the left of the SHORT indictor and is used to manually place a short across the battery under test.

HIGH V indicator is used to display high battery voltage alarms.

HIGH V alarm trimpot compares the battery voltage to a preset level that is set by the test operator. This voltage level can be changed through the use of a trimpot adjustment located under the HIGH V label. A voltage corresponding to this level can be read with a DVM connected across the red test point jack (located under the HIGH V indicator) and the GND jack. This voltage level is off by a factor of 10 (.99 Volts equals 9.9 Volts). If this condition is sensed, the battery under test is placed in an open circuit state.

LOW V indicator is used to display low battery voltage alarms.

LOW V alarm compares the battery voltage to a preset level that is set by the test operator. This voltage level can be changed through the use of a trimpot adjustment located under the LOW V label. A voltage corresponding to this level can be read with a DVM connected across the red test jack (located under the LOW V indicator) and the GND jack. This voltage level is off by a factor of 10 (.45 Volts equals 4.5 Volts). If this condition is sensed, the battery under test is placed in an open circuit state.

HIGH A indicator is used to display high current alarms.

HIGH A alarm compares the battery test current to a preset level that is set by the test operator. This voltage level can be changed through the use of a trimpot adjustment located under the HIGH A label. A voltage corresponding to this level can be read with a DVM connected across the red test point jack (located under the HIGH A indicator) and the GND jack. This voltage level is off by a factor of 100 (.1 Volt equals 10 Amps). If this condition is sensed, the battery under test is placed in an open circuit state.

AC POWER lamp indicates when AC power is applied to the unit.

The AC POWER switch applies AC power to the unit.

SYSTEM TIME OUT indicator is used to display when the remote test controlling device (HP9000 and HP3497A) is locked up. This condition places all batteries being controlled by this unit in an open circuit state.

The SYSTEM TIME OUT switch is used to re-enable test control capability to the test controller (HP9000 or HP3497A) after a time out condition has been sensed.

Located on the back of the unit are 10 I/O card slots and a 6 pin terminal block. Slot 1 contains the unit's System Timeout card and slots 2 through 10 for Battery Test Control cards.

System Timeout Card

The function of the system time out circuit is to protect the batteries from being overcharged or discharged in the event the test controller (HP9000 or HP3497A) locks up. This is accomplished by counting the number of minutes between SCAN operations. If the count is allowed to reach a predetermined count, test operations will be suspended and all batteries placed in an open circuit state. The timeout count is cleared at the end of each SCAN operation.

The preset timeout count is set by a small 4 position dip switch located on the system timeout card. An open switch setting corresponds to a logic 1 level and a closed setting a logic 0 level. The switch count is in binary with switch position 1 being the LSB. All timeout counts should be set to a number greater than 3 and less than 15.

The 6 pin terminal block is also used as part of the system timeout operation. Terminal block pins 1 and 2 are used to monitor the system's timeout status by measuring a voltage level. A reading of 0 Volts would indicate a normal system state, 5 Volts a timeout condition. Terminal block pins 3 and 4 are used by the test controller to clear the timeout count. Pins 5 and 6 are used by the test controller to reset the System Timeout circuit after a timeout condition has been sensed.

Battery Test Control Card

The battery test control cards located in slots 2 through 10 are all identical. The cards contain circuitry used in controlling battery test operations and hardware alarm limit monitoring. The electronic circuitry can basically be divided into three sections; test control input, hardware alarm checking, and relay control drivers.

The test control input section contain circuitry that allows for manual or remote battery test control. It also allows for an override function in which all test modes are bypassed and the battery is placed in a disconnect state when a hardware alarm or system timeout condition exists.

The alarm checking sections contain all the circuitry used to perform hardware alarm limit monitoring. This circuitry compares battery voltage and current levels with preset conditions to determine if an alarm exists. If an alarm condition does exist, it will generate a signal that will disable all test mode controls.

The relay driver section contains high powered ICs that provide 28 Volt signals used to energize the high current contactors contained in the Dual Channel Relay chassis. These contactors are used to switch the battery between charge/discharge and connect/disconnect/shortout modes.

Appendix B
High Temperature Control/Alarm System

Appendix B
High Temperature Control/Alarm System

Since the arrival of Sodium Sulfur cell testing, an additional control system was added due to the operating temperature range of these cells (generally operate at 350° C). To achieve this, each cell requires a high temperature furnace and temperature controller. Presently, the Battery Test Facility can accommodate this type technology at LU25, LU27, and LU28.

Each LU that performs high temperature testing contains an additional instrumentation rack. In this rack are six temperature controllers, SCR units, and overtemp units, and one nine channel interface chassis. In addition to the rack are six MarshalTM Furnaces. For more information on these furnaces see the Operation & Maintenance Manual for the MarshallTM Furnaces. Figure 31 contains a simplified drawing of the High Temperature Control system.

Temperature Control

The temperature control operation centers around the Omega CN-2010 programmable controller. The CN-2010 features ramp and soak functions (the capability to control the temperature and its rate of change over a predetermined time span). Eight ramp and soak intervals can be programmed to hold the temperature constant, or at a constant rate of change. Each interval can have a time duration of up to 100 hours, and up to 254 repeat cycles are possible. For a complete description and operation of this controller, refer to the operator's manual for the Omega CN-2010.

The temperature controller monitors a furnace temperature and compares this reading to a preprogrammed level. The controller outputs a DC signal that varies proportionally to this temperature differential. The signal drives an SCR power controller that serves as a high-powered variable resistor. The SCR power controller varies the amount of AC voltage applied to the MarshallTM Furnace which in turn varies its internal chamber temperature. Each temperature controller also has the ability to sense high and low temperature levels as preprogrammed by the operator. Each temperature controller is backed up by an overtemp unit.

The overtemp unit monitors the temperature inside each furnace for high temperature levels as set by the front panel dial. Any temperature alarm condition automatically removes AC power from the furnace. Refer to Drawing section for temperature control rack layout and electrical schematics.

Nine Channel Alarm Interface Chassis

Each temperature control system contains a nine channel alarm interface chassis. This unit monitors each temperature controller for temperature alarm conditions. If one exists, the unit will record the type and location of the alarm. It also displays the alarm condition and location on its front panel. The unit can also receive alarm messages from the LU. Refer to Drawing section for chassis layout and electrical schematics.

Temperature Alarm Callout Configuration

This function is presently disabled, though all hardware is in place if it is needed.

The three nine channel alarm interface chassis contained within the three high temperature control systems are interfaced to an HP85/HP3497A computer/control system. The HP85 computer executes software that through the HP3497A scans each channel of the three Alarm Interface Chasses for alarm conditions. If an alarm is sensed, the computer/control system will trigger a Sense-a-Phone device. This device has the ability to make telephone calls and verbally communicate messages. The verbal messages and their meaning are as follows:

"LOW TEMPERATURE ALARM, ALERT CONDITION 1 EXISTS": There has been a low temperature limit reached in temperature control system 1.

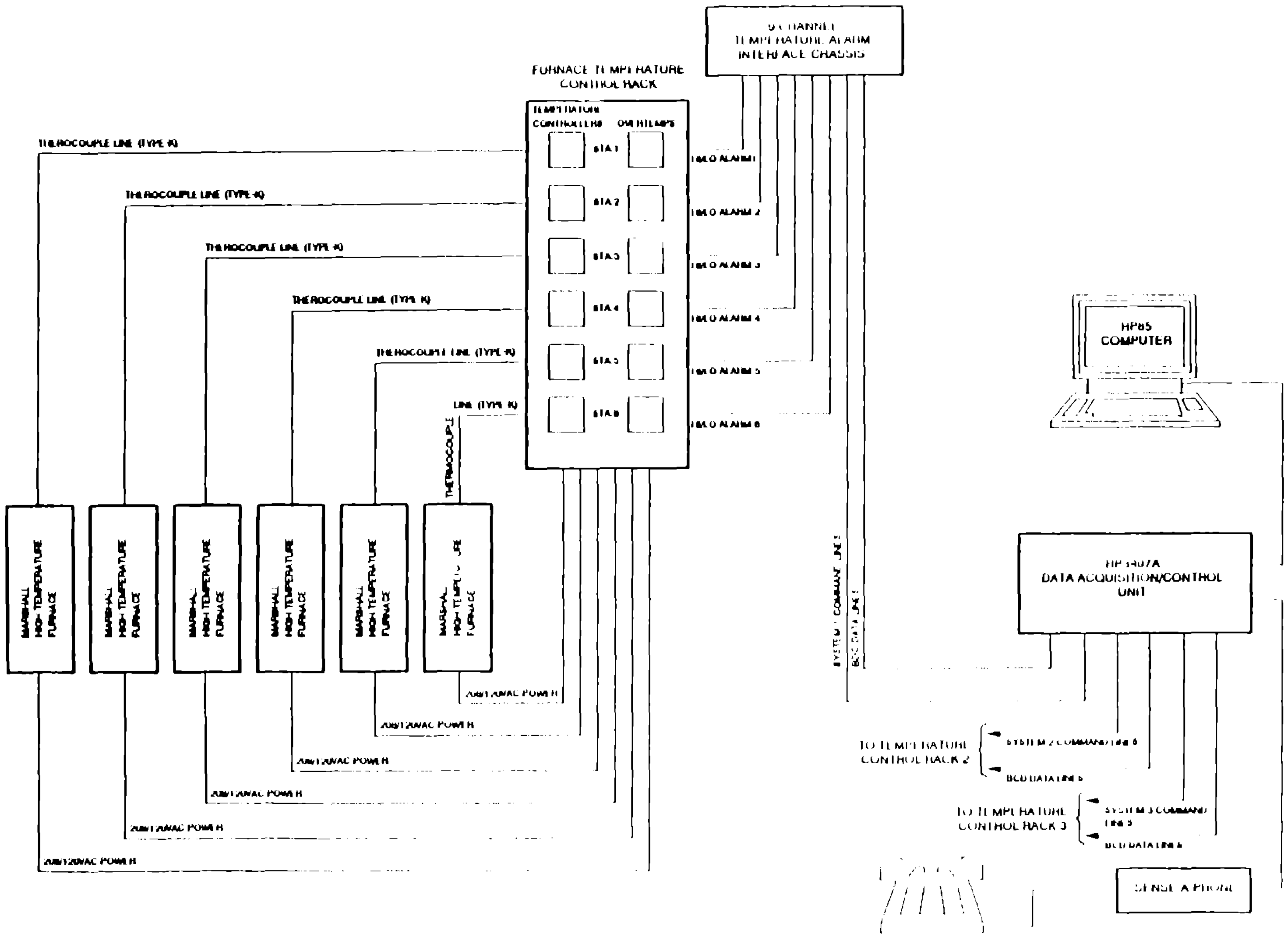
"HIGH TEMPERATURE ALARM, ALERT CONDITION 1 EXISTS": There has been a high temperature limit reached in temperature control system 2.

"ALERT CONDITION 1 EXISTS": No AC power has been sensed in temperature control system 1.

"LOW TEMPERATURE ALARM, ALERT CONDITION 2 EXISTS": There has been a low temperature limit reached in temperature control system 2.

"HIGH TEMPERATURE ALARM, ALERT CONDITION 2 EXISTS": There has been

Figure 31. Simplified Drawing of High Temperature Control System



a high temperature limit reached in temperature control system 2.

"ALERT CONDITION 2 EXISTS": No AC power has been sensed in temperature control system 2.

"LOW TEMPERATURE ALARM, ALERT CONDITION 1, ALERT CONDITION 2 EXISTS": There has been a low temperature limit reached in temperature control system 3.

"HIGH TEMPERATURE ALARM, ALERT CONDITION 1, ALERT CONDITION 2 EXISTS": There has been a high temperature limit reached in temperature control system 3.

"ALERT CONDITION 1, ALERT CONDITION 2 EXISTS": No AC power has been sensed in temperature control system 3.

The Sense-a-Phone can store up to five telephone numbers of laboratory operators to call if any type of alarm is sensed. Callouts start with the first telephone number in the list. If there is no response, the next number will be called. This will continue indefinity until a response is received. The response is in the form of a return telephone call, allowing it to ring nine times. The Sense-a-Phone will reply with a "WARNING MESSAGE RECEIVED" response.

Configuring the Auto-Callout Function

To enable the auto-callout function, the following setup procedures are required.

(1) All active temperature channels must be activated on the front panel for the nine channel alarm interface chassis. Note: Press the RESET button to clear all old alarms.

Table B1. Auto-Callout Configuration Table

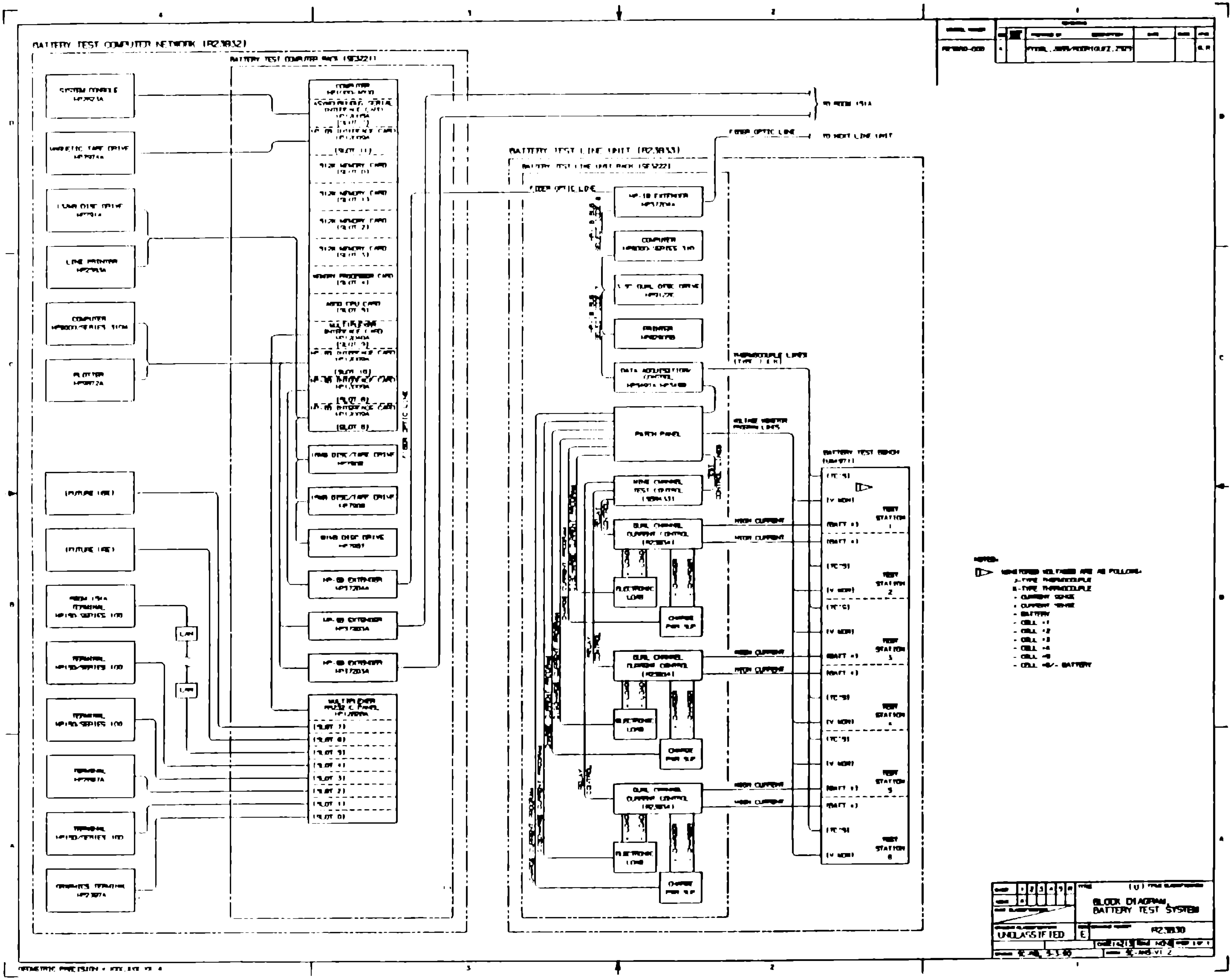
Hi/Lo Temperature Channel #	Test Station #	Line Unit #
1 / 2	1	1
3 / 4	2	1
5 / 6	3	1
7 / 8	4	1
9 / 10	5	1
11 / 12	6	1
19	208 VAC Power Monitor	1
20	120 VAC Power Monitor	1
21 / 22	1	2
23 / 24	2	2
25 / 26	3	2
27 / 28	4	2
29 / 30	5	2
31 / 32	6	2
39	208 VAC Power Monitor	2
40	120 VAC Power Monitor	2
41 / 42	1	3
43 / 44	2	3
45 / 46	3	3
47 / 48	4	3
49 / 50	5	3
51 / 52	6	3
59	208 VAC Power Monitor	3
60	120 VAC Power Monitor	3

(2) Install and run a software program in the HP85 called PHONE.

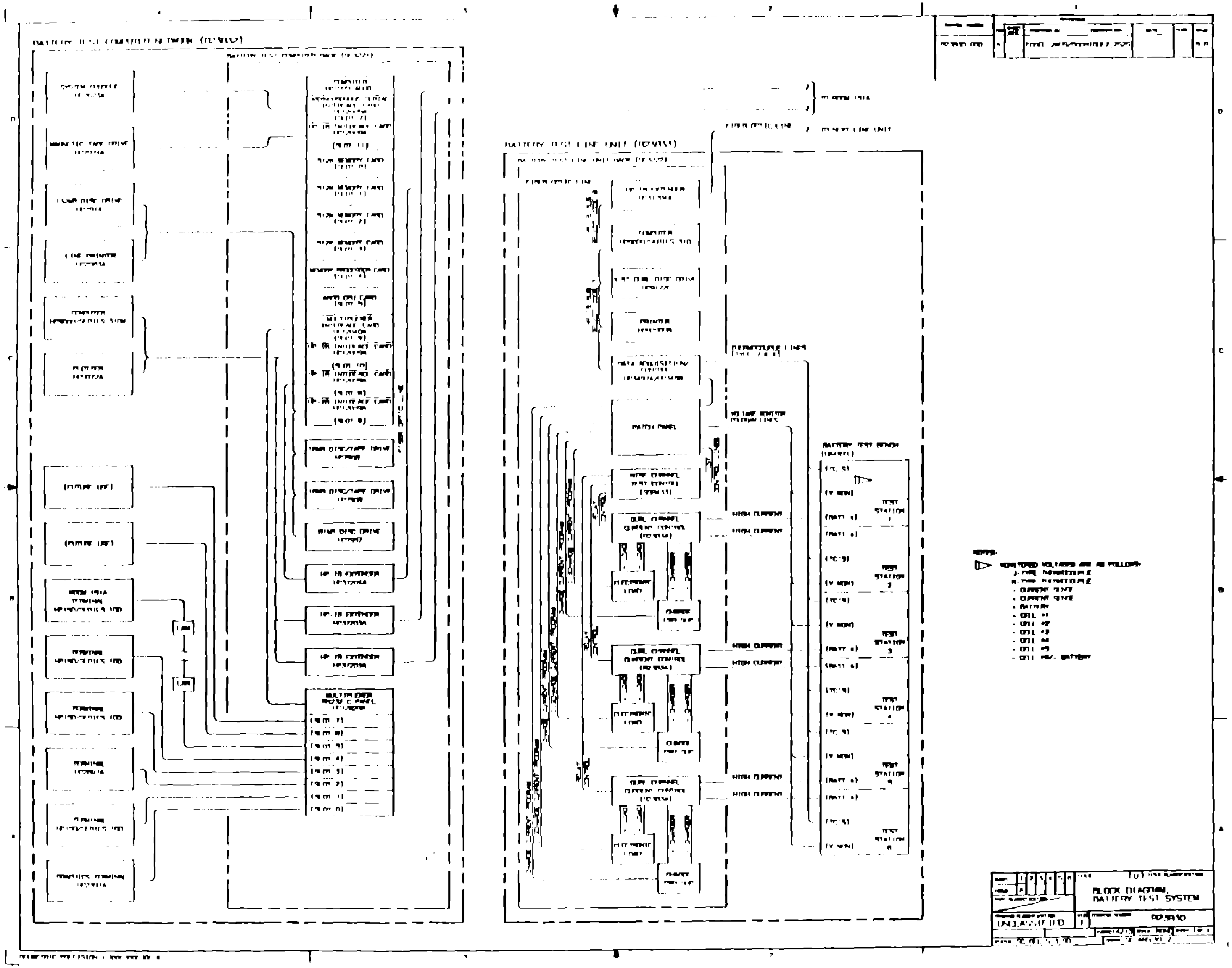
(3) Modify the Temperature Channel configuration within the PHONE program; set all inactive channels to -1.

Table B1 lists all alarm channels that are presently configured into the PHONE program.

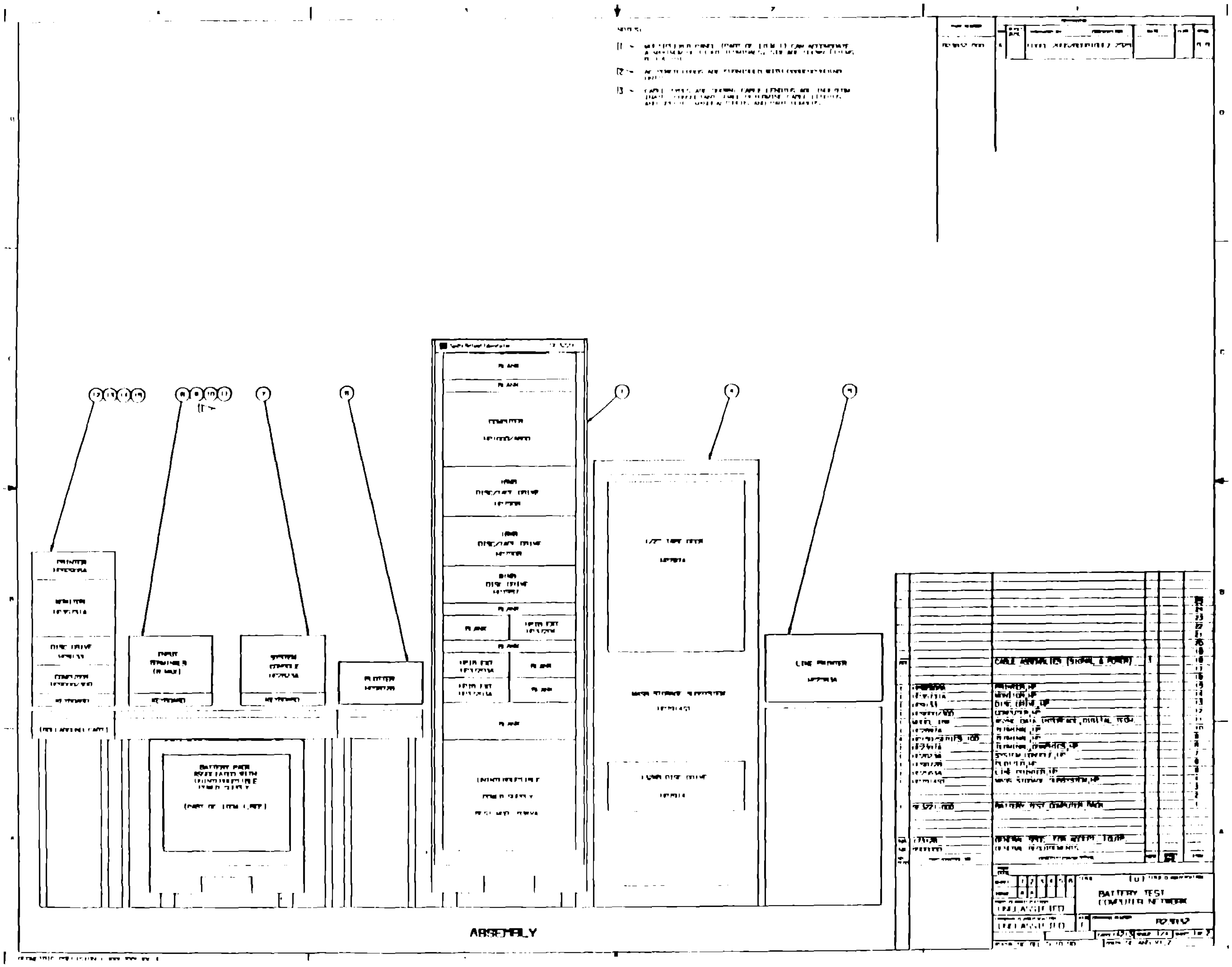
Appendix C
Drawings for Battery Test Facility Computer Network Layout and Electrical Interconnects

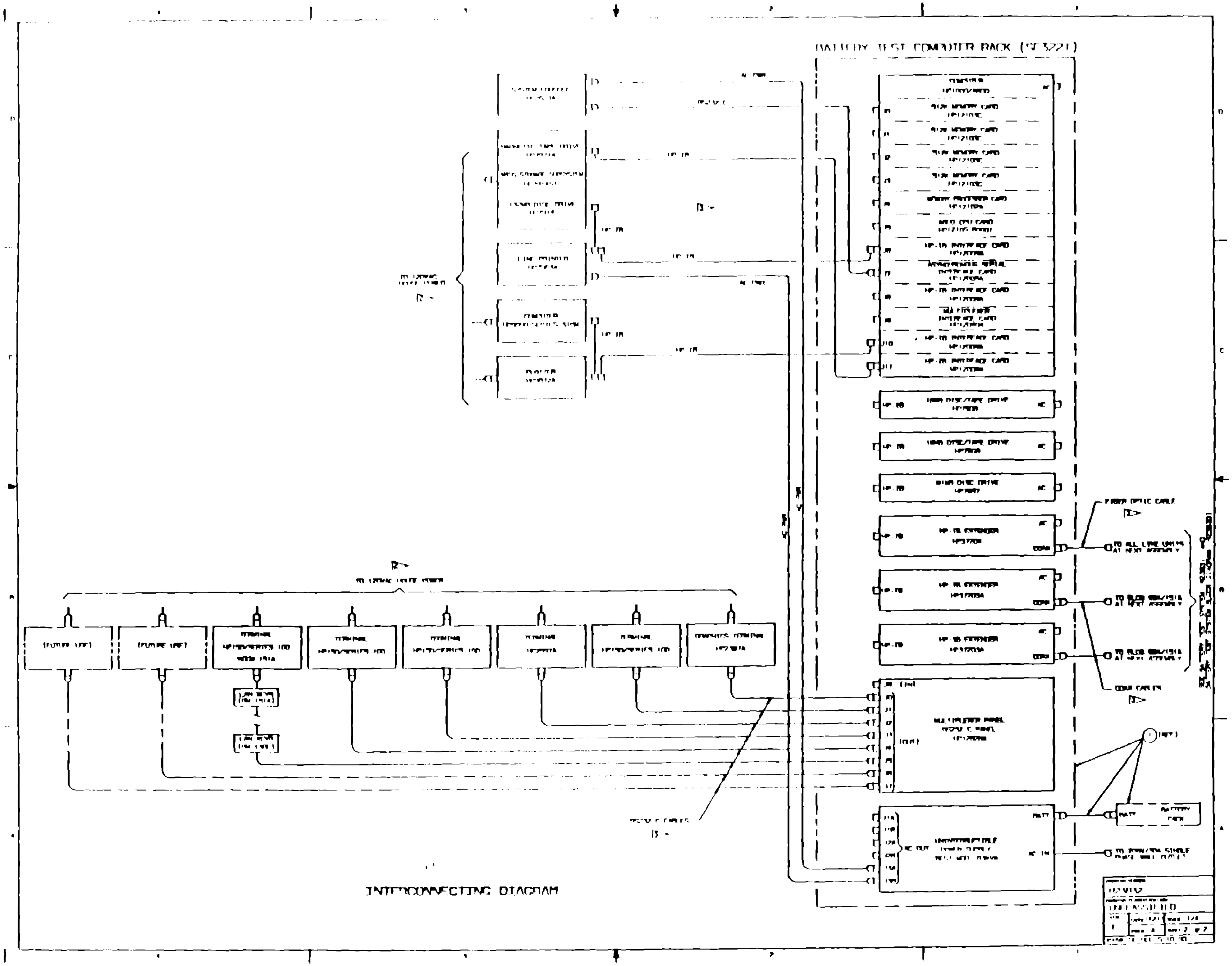


BATTERY TEST COMPUTER NETWORK (R23832)
SYSTEM CONSOLE
LINE PRINTER
PLOTTER
(FUTURE USE)
(FUTURE USE)
LAN
LAN
BATTERY TEST LINE UNIT (R23833)
FIBER OPTIC LINE
TO NEXT LINE UNIT
PATCH PANEL
DUAL CHANNEL CURRENT CONTROL
ELECTRONIC LOAD
CHARGE PWR SUP
HIGH CURRENT
BATTERY TEST BENCH
TEST STATION
BLOCK DIAGRAM, BATTERY TEST SYSTEM
UNCLASSIFIED
R23830



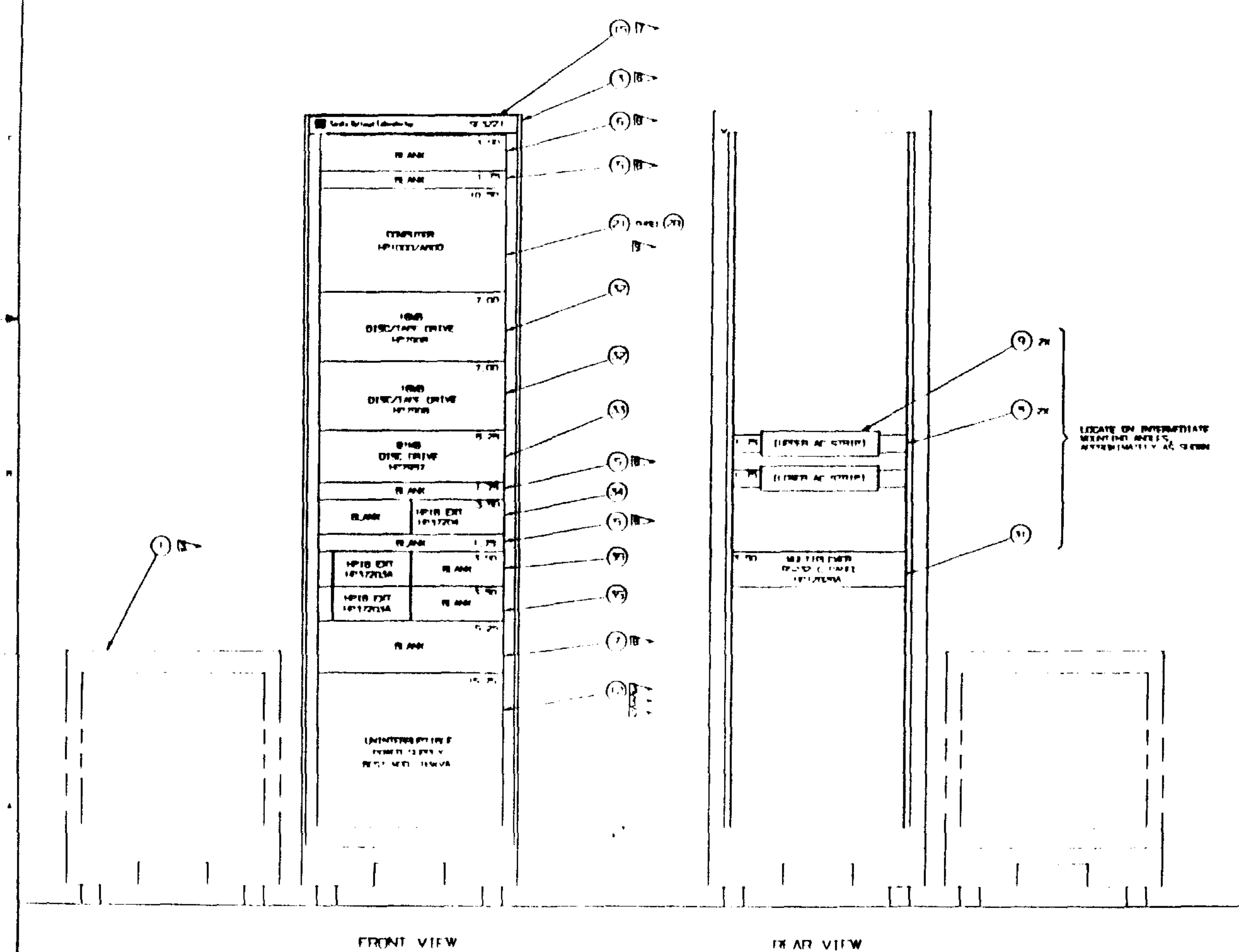
BATTERY TEST LINE UNIT
HIGH CURRENT
DUAL CHANNEL CURRENT CONTROL
ELECTRONIC LOAD
TEST STATION
BLOCK DIAGRAM,
BATTERY TEST SYSTEM
UNCLASSIFIED


NOTES:
PRINTER
DISC DRIVE
KEYBOARD
INPUT TERMINALS
SYSTEM CONSOLE
PLOTTER
BLANK
COMPUTER
DISC/CART. DRIVE
DISC DRIVE
UNINTERRUPTIBLE POWER SUPPLY
1/2" TAPE DRIVE
MASS STORAGE SUBSYSTEM
LINE PRINTER
BATTERY PACK
CABLE ASSEMBLIES (SIGNAL & POWER)
BATTERY TEST COMPUTER NETWORK
UNCLASSIFIED
UNCLASSIFIED
ASSEMBLY



INTERCONNECTING DIAGRAM

NOTES:



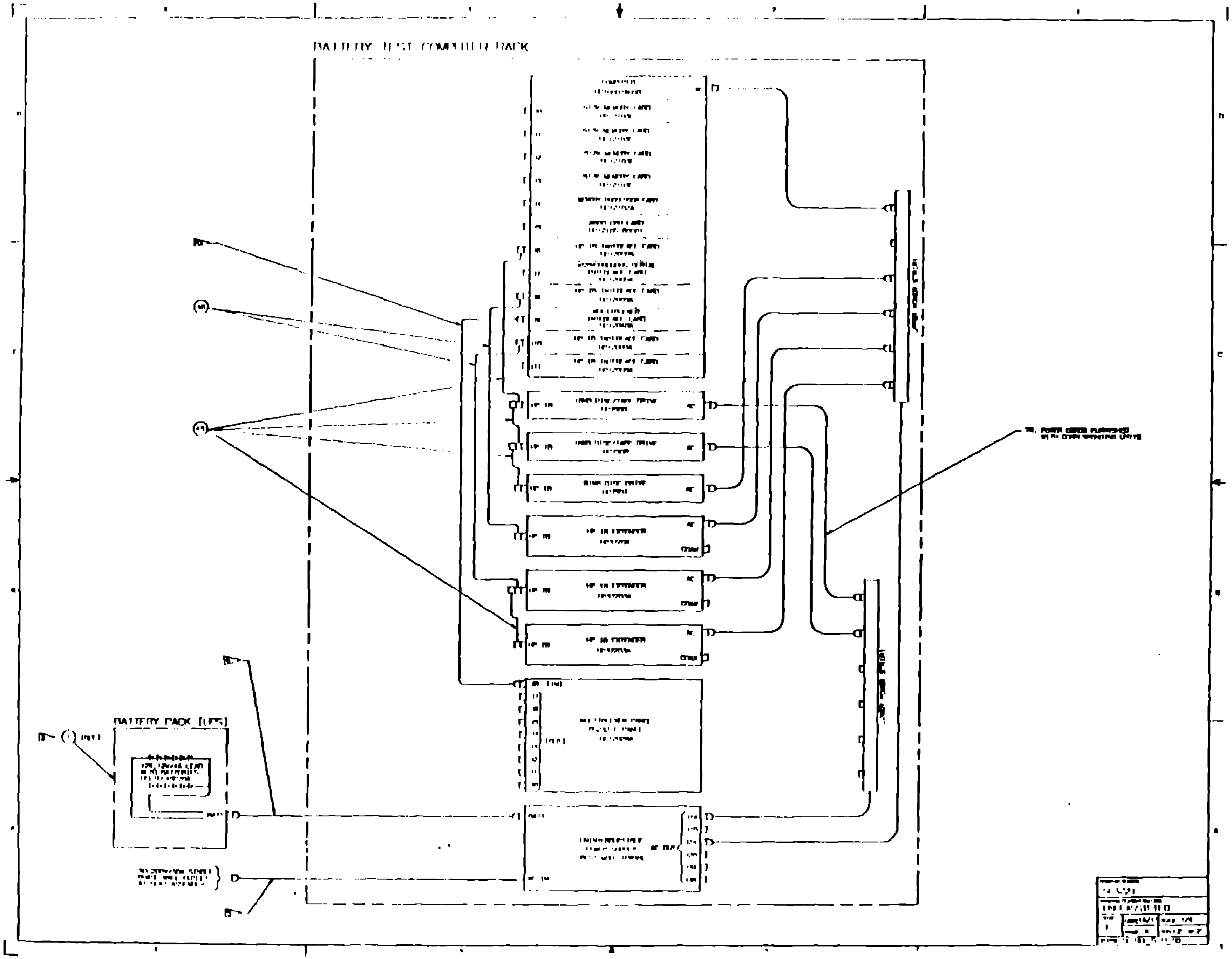
Qty	Part No.	Description	Item
2	[illegible]	CABLE ASSY, HP-IB (3M), HP	
4	[illegible]	CABLE ASSY, HP-IB (1M), HP	
2	HP37203A	EXTENDER, HP-IB, HP	35
1	HP37204A	EXTENDER, HP-IB, HP	34
1	HP7912	DISC DRIVE, 65MB, HP	33
2	HP7908	DISC/TAPE DRIVE, 16MB, HP	32
1	[illegible]	MULTIPLEXER, RS232C PANEL, HP	31
1	[illegible]	MULTIPLEXER INTERFACE CARD, HP	28
1	[illegible]	ASYNCHRONOUS SERIAL INTERFACE CARD, HP	27
4	[illegible]	HP-IB INTERFACE CARD, HP	26
1	[illegible]	A900 CPU CARD, HP	25
1	[illegible]	MEMORY PROCESSOR CARD, HP	24
4	[illegible]	MEMORY CARD, 512KB, HP	23
1	HP1000/A900	COMPUTER, HP	22
1	[illegible]	ROM, 70 CARD, HP	21
AR	[illegible]	PAINT, ENAMEL, [illegible] GRAY, HP	16
AR	[illegible]	CHANNEL [illegible], 1", [illegible]	15
1	[illegible]	UNINTERRUPTIBLE PWR SUPPLY, BEST	12
2	[illegible]	AC PWR STRIP, 6 OUTLETS, TOPAZ	9
1	MAP 519	PANEL, BLANK, 5.25", PREMIER MET. PROD	7
1	MAP 319	PANEL, BLANK, 3.50", PREMIER MET. PROD	6
5	MAP 119	PANEL, BLANK, 1.75", PREMIER MET. PROD	5
1	[illegible]	CABINET, ELEC. EQUIP., ELECTRORACK	3
1		SUB ASSY, BATTERY PACK	1
NR	[illegible]	GENERAL SPEC. FOR ACCEPTANCE EQUIP	
NR	[illegible]	GENERAL REQUIREMENTS	

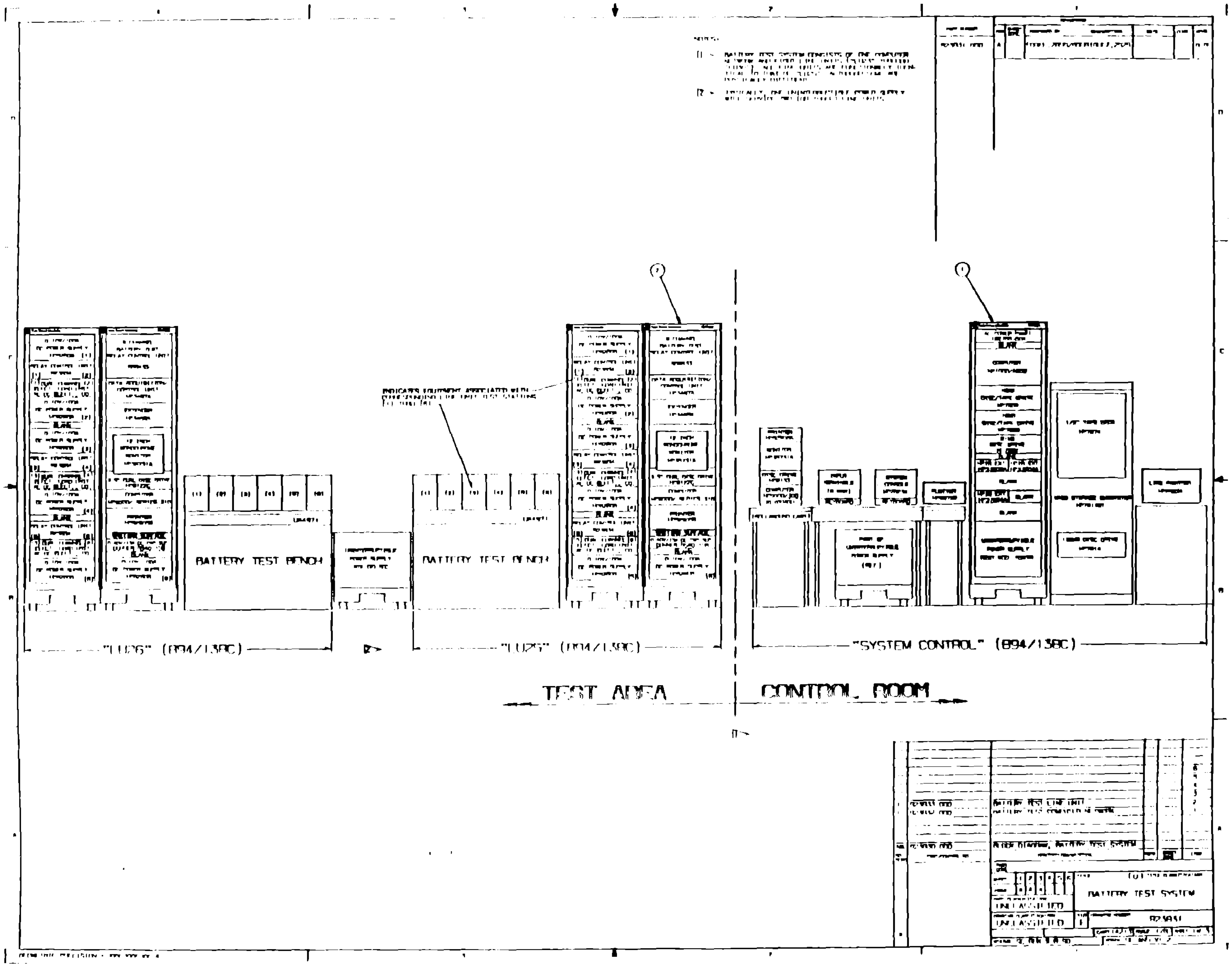
BATTERY TEST COMPUTER RACK

UNCLASSIFIED

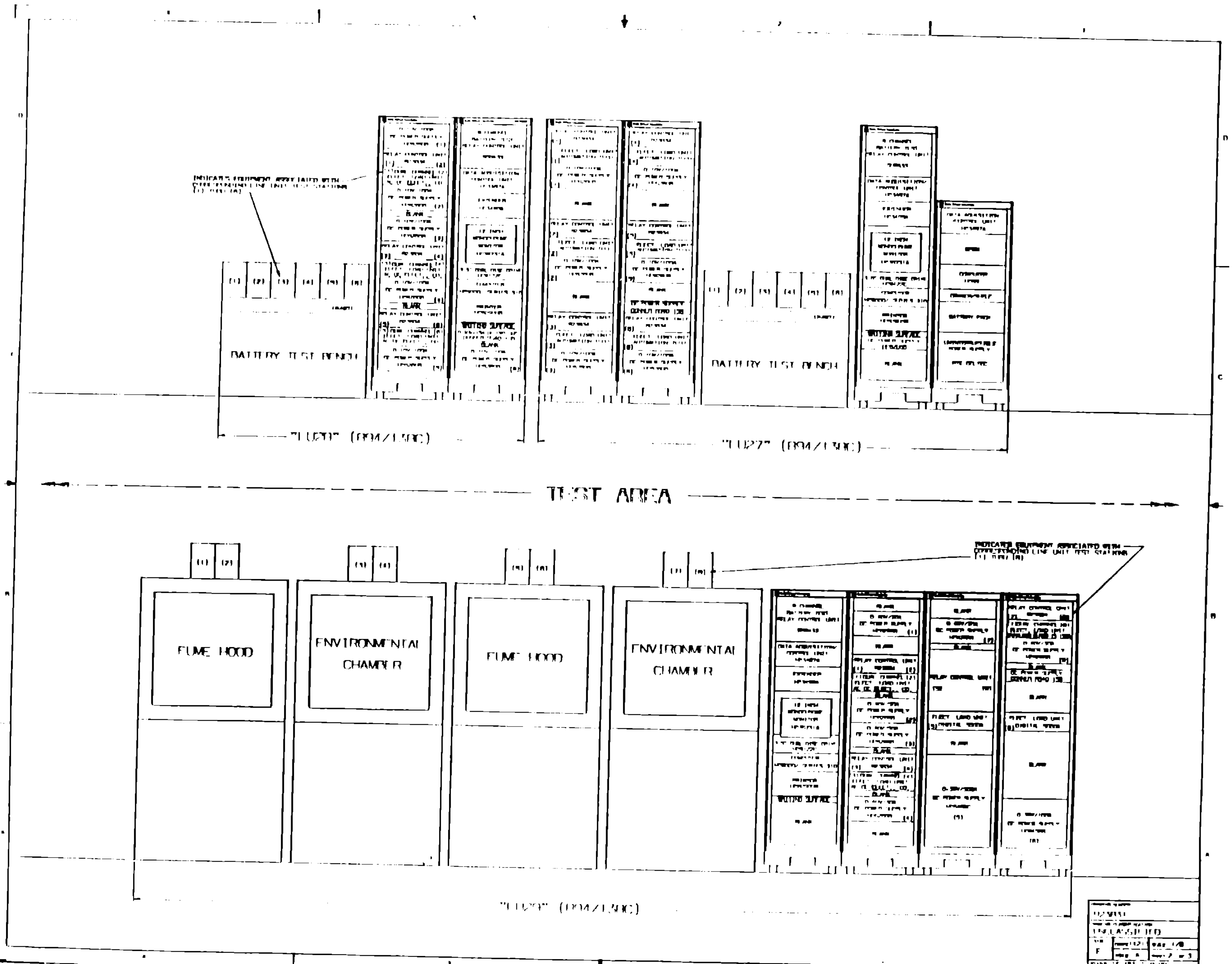
UNCLASSIFIED

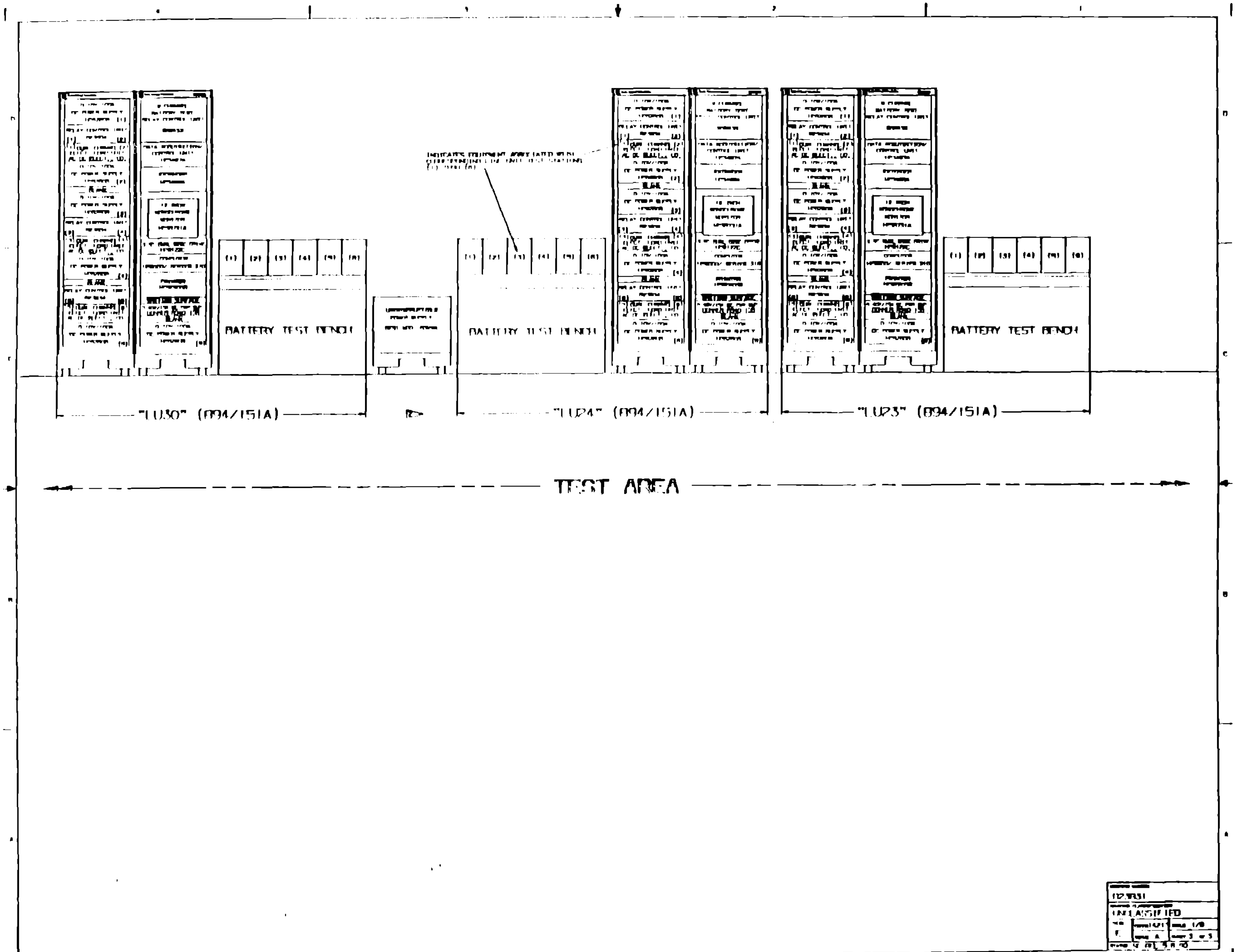
SF3221


BATTERY TEST COMPUTER RACK
BATTERY PACK (UPS)



BATTERY TEST BENCH
BATTERY TEST BENCH
"LU26" (B94/138C)
"SYSTEM CONTROL" (B94/138C)
TEST AREA
CONTROL ROOM
BATTERY TEST SYSTEM
UNCLASSIFIED
UNCLASSIFIED


BATTERY TEST BENCH
BATTERY TEST BENCH
TEST AREA
FUME HOOD
ENVIRONMENTAL CHAMBER
FUME HOOD
ENVIRONMENTAL CHAMBER


BATTERY TEST BENCH
BATTERY TEST BENCH
BATTERY TEST BENCH
"LU30" (894/151A)
"LU24" (894/151A)
"LU23" (894/151A)
TEST AREA
UNCLASSIFIED

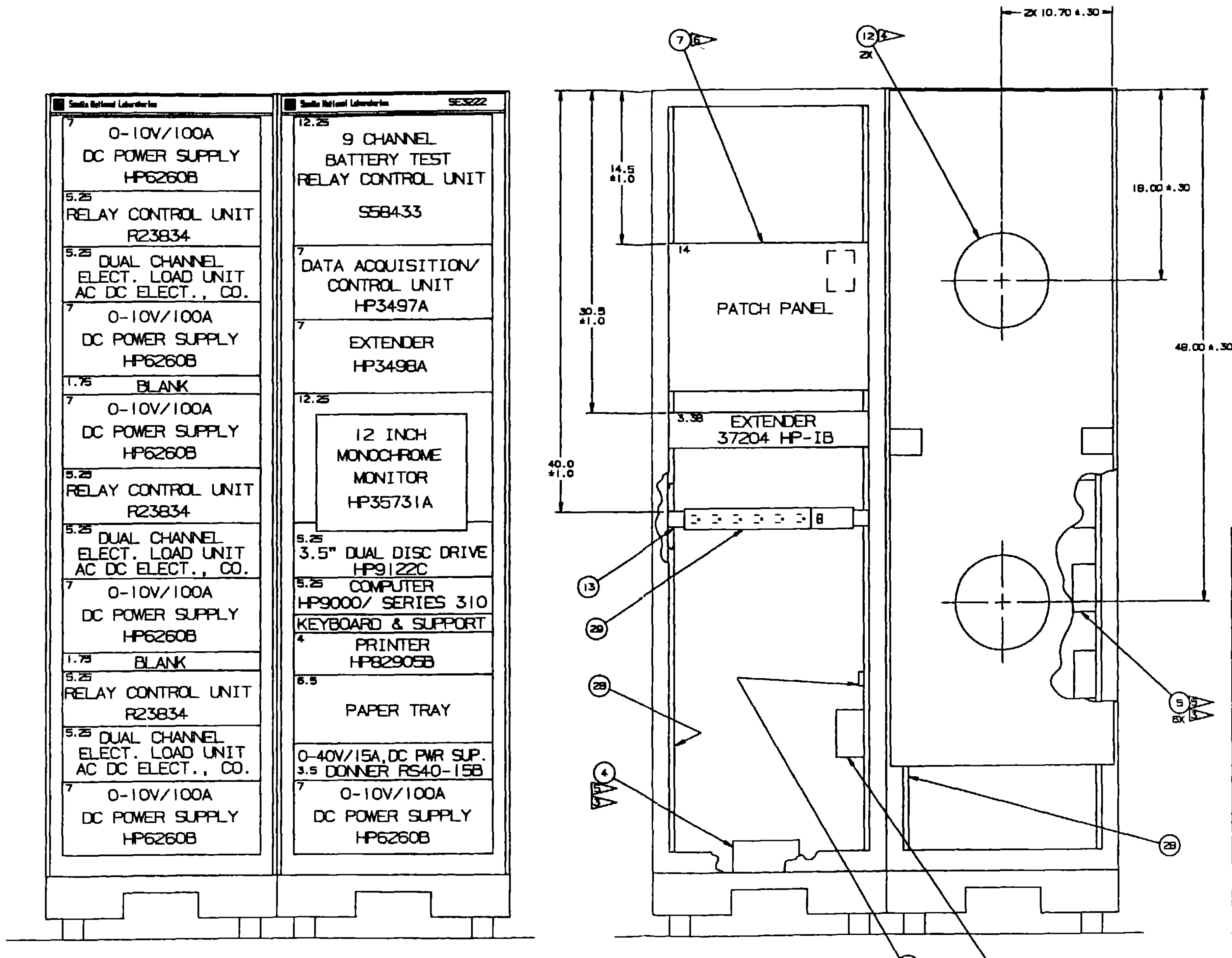
Typical Line Unit

Layout And Electrical Interconnects

PART NUMBER	ISS	SHEET ZONE	PREPARED BY / DESCRIPTION	DATE	CHKR	AP
SE3222-000	A		RRDEVRIES 2850/ B. RODRIGUEZ 2525			GF

NOTES:

1. GENERAL REQUIREMENTS PER 9900000.
2. FOR SPECIFIC PROCESSING, MANUFACTURING & ASSEMBLY REQUIREMENTS NOT OTHERWISE COVERED IN THIS DRAWING, SEE 173126.
3. BUILD ITEM PER ENGINEER'S INSTRUCTIONS.
4. MATCH DRILL ITEM 12 TO ITEM 11, INSTALL ITEM 12 PER MANUFACTURERS INSTRUCTIONS, LOCATE APPROXIMATELY AS SHOWN.
5. LOCATE APPROXIMATELY AS SHOWN.
6. SEE SHEET 7 FOR DETAIL & ASSEMBLY.



FRONT VIEW

REAR VIEW

NO. REQD	PART/CONTROL NO.	DESCRIPTION/MATERIAL	NOTE	SHEET ZONE	ITEM
1	353-11-08-001	TERMINAL BOARD, 8 TERM. TRW			30
1		POWER STRIP, ELEC, 6 OUT. TOPAZ			29
2	020G8606	CONN STRIP, ELEC, 12 OUT. WIREMOLD			28
					27
					26
					25
1	PR-30	POWER SUPPLY, 28V PHILBRICK			24
1	RS40-15B	POWER SUPPLY, DC, 0-40V/15A DONNER			23
1	82905B	PRINTER HP			22
1	35731A	MONITOR, MONOCHROME, 12 IN. HP			21
1	9122C	DISC DRIVE, DUAL, 3.5 IN. HP			20
1	9000	COMPUTER, SERIES 310 HP			19
6	6260B	POWER SUPPLY, DC, 0-1-V/100A HP			18
1	3498A	EXTENDER HP			17
1	3497A	CONTROL, DATA ACQUISITION HP			16
3		LOAD UNIT, ELEC, DUAL CHANNEL AC-DC			15
1	HP46021A	KEYBOARD HP			14
4	PNA-805212-1-EN-L	PANEL, BLANK, HT 1.75 IN. EMCOR			13
2	020189	FAN, VENT, MOD. #CL2T2 EG&G			12
1	105204-70	CABINET, ELEC, DUAL BAY ELECTRORACK			11
					10
					9
1		KEYBOARD SUPPORT	3		8
1		PATCH PANEL ASSY.	6		7
					6
6		SWITCH BOX, CONSTANT POWER	3		5
1		RELAY TOGGLE UNIT, 28V	3		4
36		CABLE ASSY.	5,3		3
1	S58433-000	TEST CONTROL, 9 CHANNEL			2
3	R23834-000	RELAY CONTROL UNIT			1
NA	9919100	MARKING, GENERAL METHODS			
NA	173126	GEN. SPEC. FOR ACCEPT. EQUIPMENT			
NA	9900000	GENERAL REQUIREMENTS			

PART CODE

SHEET	1	2	3	4	5	6	7
ISSUE	A	A	A	A	A	A	A

TITLE (U) TITLE CLASSIFICATION

BATTEREY TEST LINE UNIT RACK

PART CLASSIFICATION UNCLASSIFIED

DRAWING CLASSIFICATION UNCLASSIFIED

SIZE E DRAWING NUMBER SE3222

CAGEC 14213 SCALE 1/4 SHEET 1 OF

STATUS SC-REL-5-4-90 ORIGIN SC-ANS-V1.2

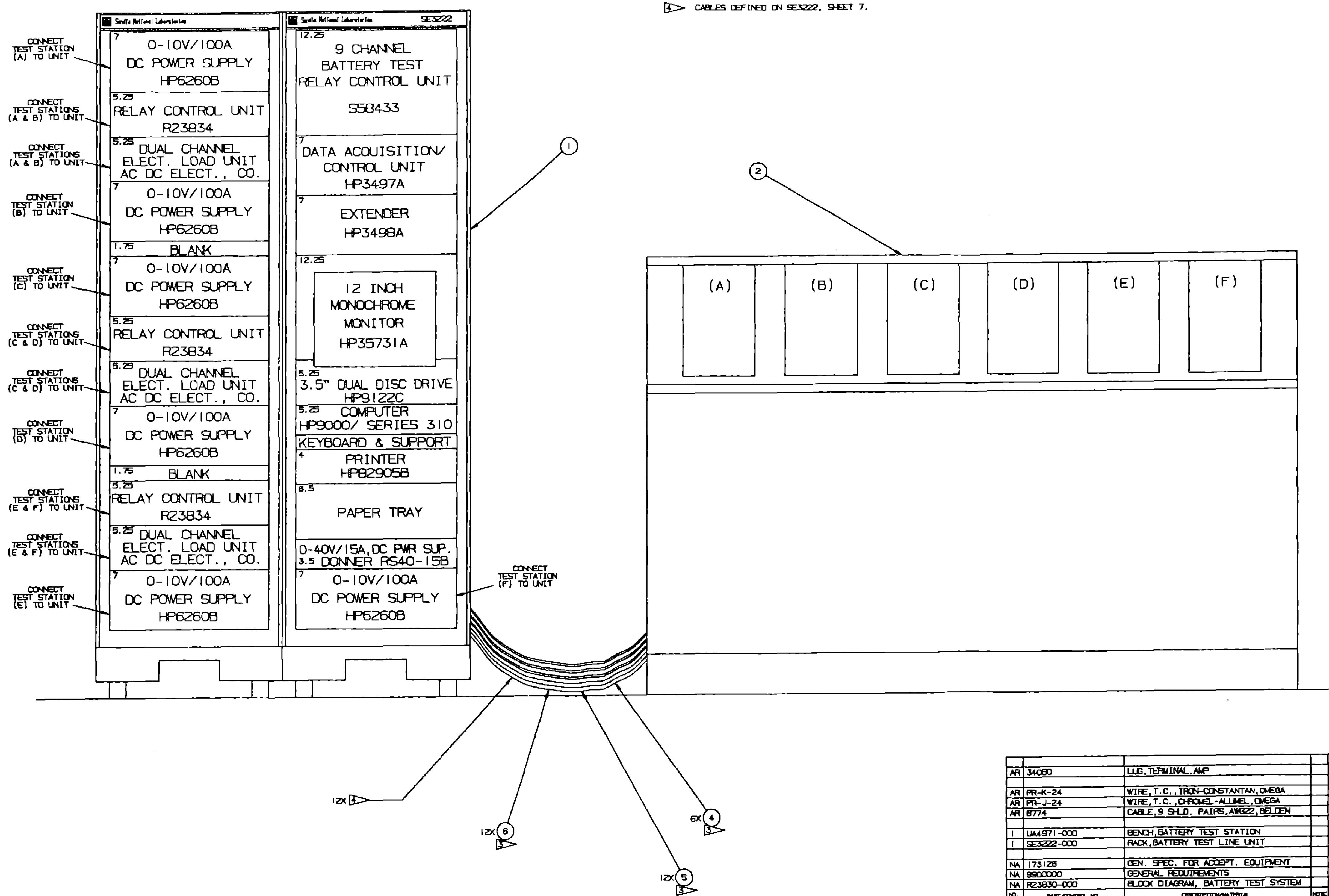
PART NUMBER	ISS	SHEET ZONE	PREPARED BY / DESCRIPTION	DATE	CHKR	APVD
R23833-000	A		RADEVRIES 2850/ B. RODRIGUEZ 2525			GPR

NOTES:

1. GENERAL REQUIREMENTS PER 9900000.
2. FOR SPECIFIC PROCESSING, MANUFACTURING & ASSEMBLY REQUIREMENTS NOT OTHERWISE COVERED IN THIS DRAWING, SEE 173126.

3. WIRE & CABLE LENGTHS TO BE DETERMINED AT ASSEMBLY AS DIMENSION MAY VARY FROM ONE LINE UNIT TO THE NEXT.

4. CABLES DEFINED ON SE3222, SHEET 7.



NO. REQD	PART/CONTROL NO.	DESCRIPTION/MATERIAL	NOTE	SHEET ZONE	ITEM
					9
AR	34080	LUG, TERMINAL, AMP			8
					7
AR	PR-K-24	WIRE, T.C., IRON-CONSTANTAN, OMEGA			6
AR	PR-J-24	WIRE, T.C., CHROMEL-ALUMEL, OMEGA			5
AR	8774	CABLE, 9 SHLD. PAIRS, AWG22, BELDEN			4
					3
1	UA4971-000	BENCH, BATTERY TEST STATION			2
1	SE3222-000	RACK, BATTERY TEST LINE UNIT			1
NA	173126	GEN. SPEC. FOR ACCEPT. EQUIPMENT			
NA	9900000	GENERAL REQUIREMENTS			
NA	R23830-000	BLOCK DIAGRAM, BATTERY TEST SYSTEM			

PART CODE

SHEET	1	2	3	4	5	6
ISSUE	A	A				

PART CLASSIFICATION: UNCLASSIFIED

TITLE (U) TITLE CLASSIFICATION

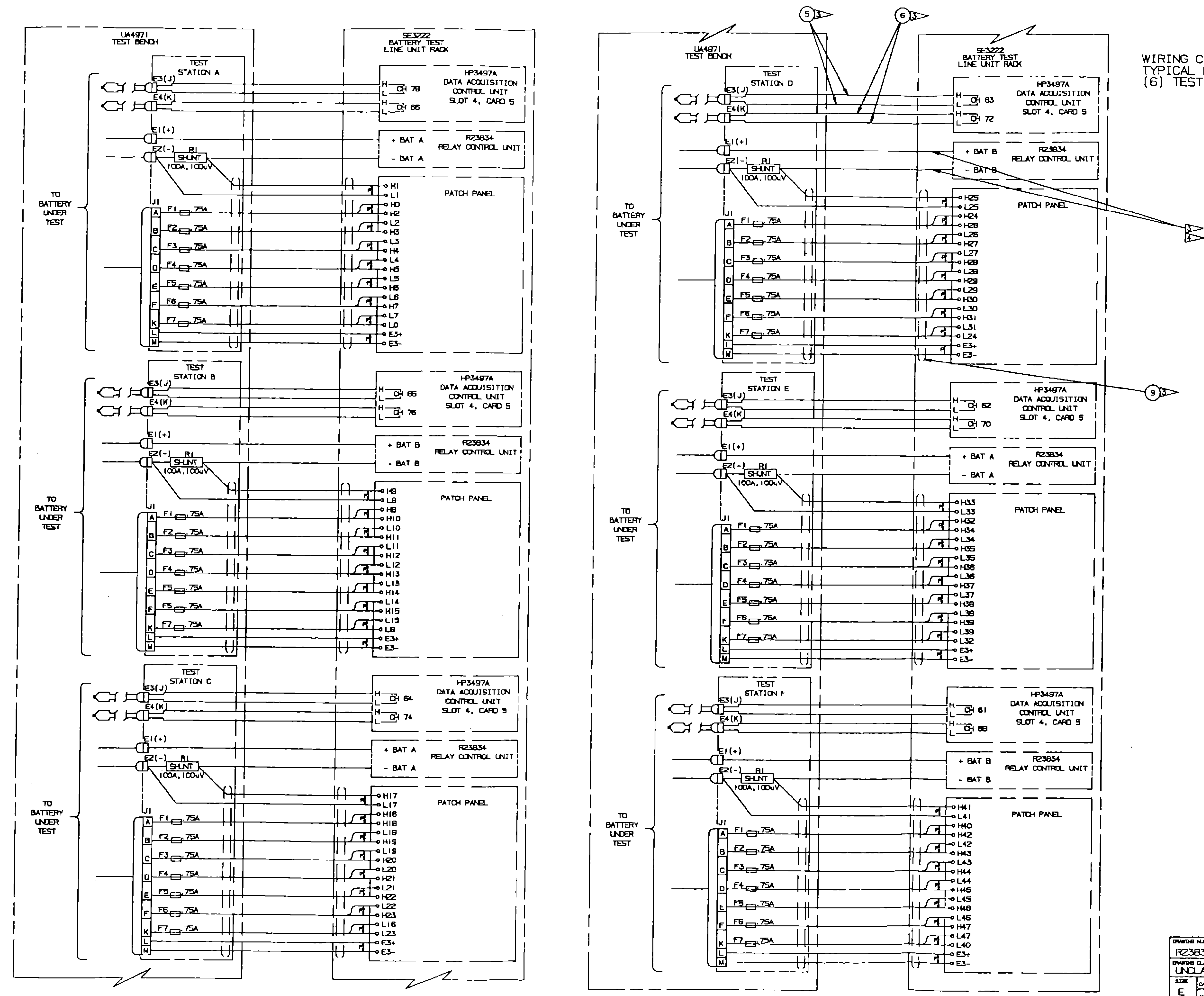
BATTERY TEST LINE UNIT

DRAWING CLASSIFICATION: UNCLASSIFIED

SIZE: E DRAWING NUMBER: R23833

CAGEC 14213 SCALE 1/4 SHEET 1 OF 2

STATUS SC-REL-5-4-90 ORGIN SC-ANS-V1.2



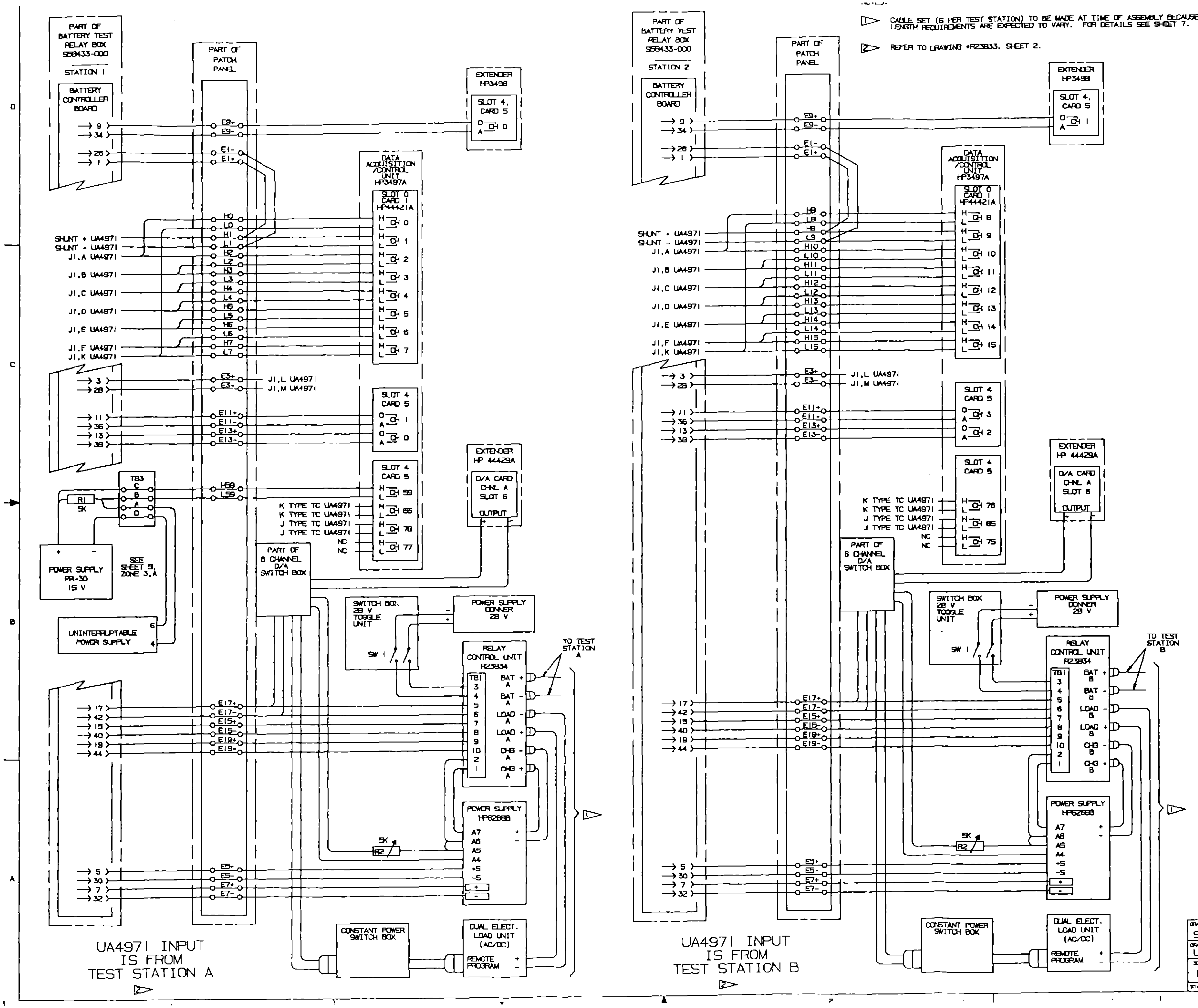
WIRING CALLOUTS ARE TYPICAL FOR EACH OF (6) TEST STATIONS.

DRAWING NUMBER	R23833
DRAWING CLASSIFICATION	UNCLASSIFIED
SIZE E	CAGEC 14213 · SCALE NONE
	ISSUE A · SHEET 2 OF
STATUS	SC-REL-5-4-90

NOTES:

1. CABLE SET (6 PER TEST STATION) TO BE MADE AT TIME OF ASSEMBLY BECAUSE LENGTH REQUIREMENTS ARE EXPECTED TO VARY. FOR DETAILS SEE SHEET 7.

2. REFER TO DRAWING #R23833, SHEET 2.

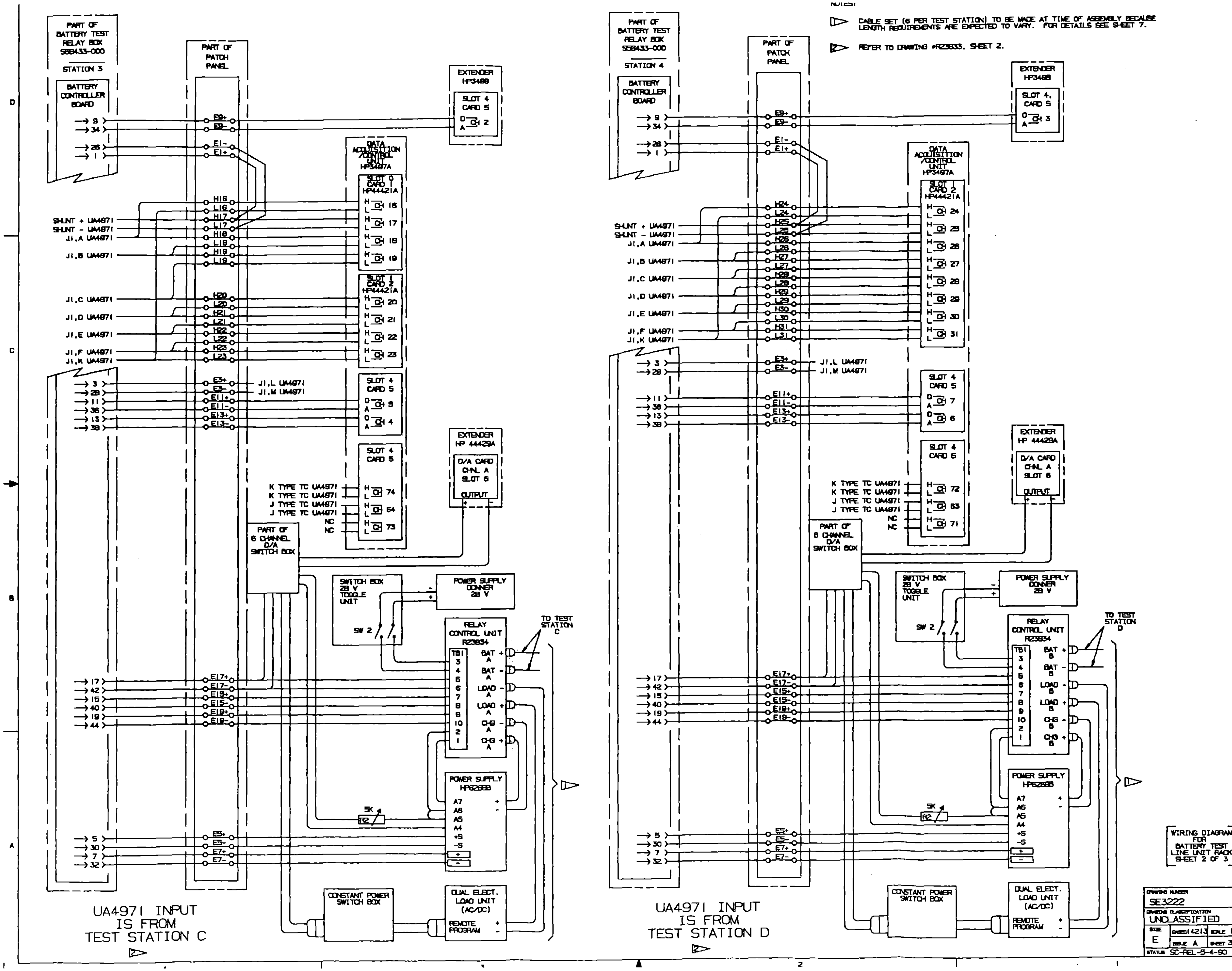


WIRING DIAGRAM FOR BATTERY TEST LINE UNIT RACK SHEET 1 OF 3

DRAWING NUMBER	SE3222
DRAWING CLASSIFICATION	UNCLASSIFIED
SIZE E	CAGEC 14213 · SCALE NONE
ISSUE A	SHEET 2 OF
STATUS	SC-REL-5-4-90

NOTES:

1. CABLE SET (6 PER TEST STATION) TO BE MADE AT TIME OF ASSEMBLY BECAUSE LENGTH REQUIREMENTS ARE EXPECTED TO VARY. FOR DETAILS SEE SHEET 7.
2. REFER TO DRAWING #R23833, SHEET 2.

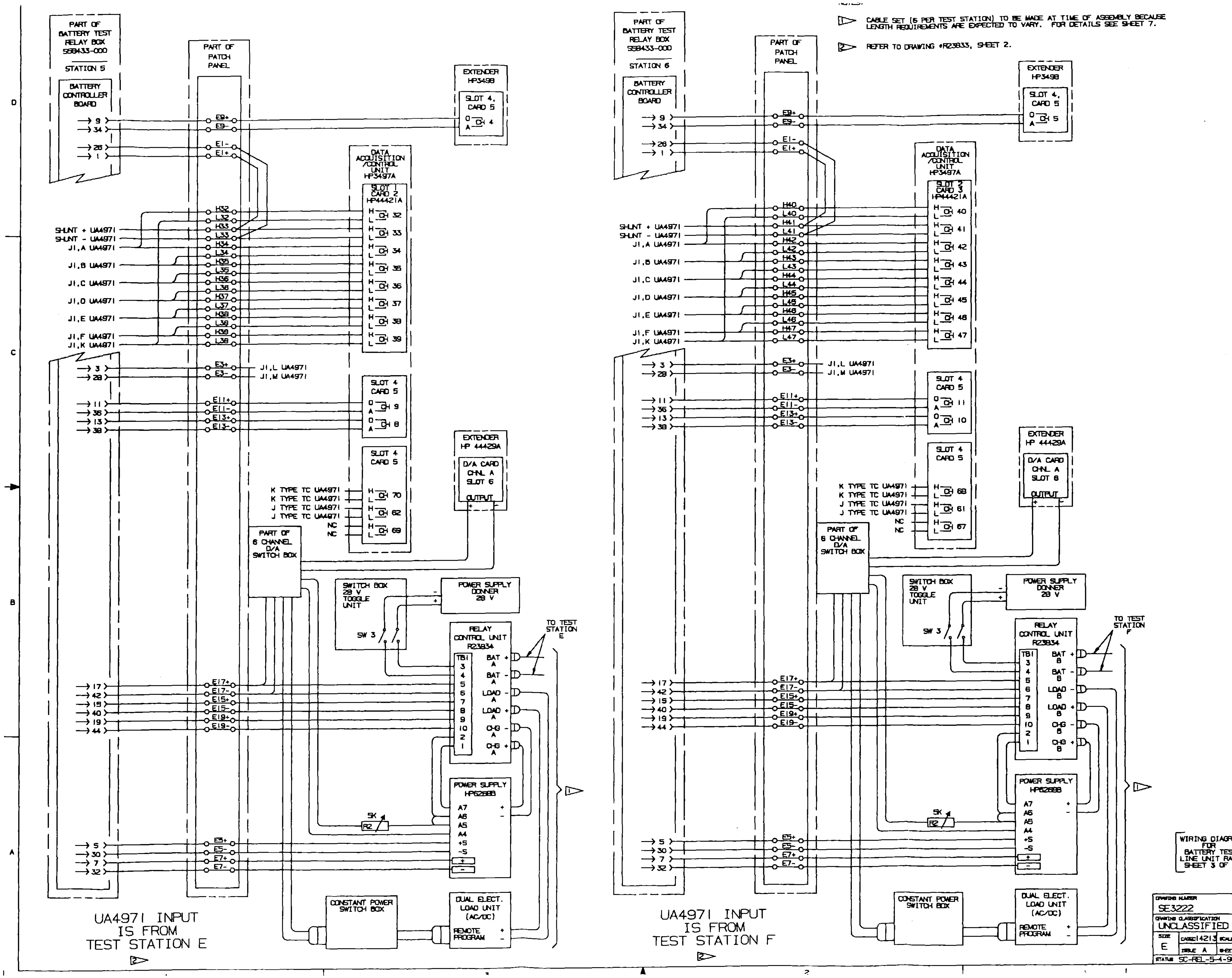


WIRING DIAGRAM FOR BATTERY TEST LINE UNIT RACK SHEET 2 OF 3

DRAWING NUMBER	SE3222
DRAWING CLASSIFICATION	UNCLASSIFIED
SIZE	E
CAGE	14213
SCALE	NONE
ISSUE	A
SHEET	3 OF 7
STATUS	SC-REL-5-4-90

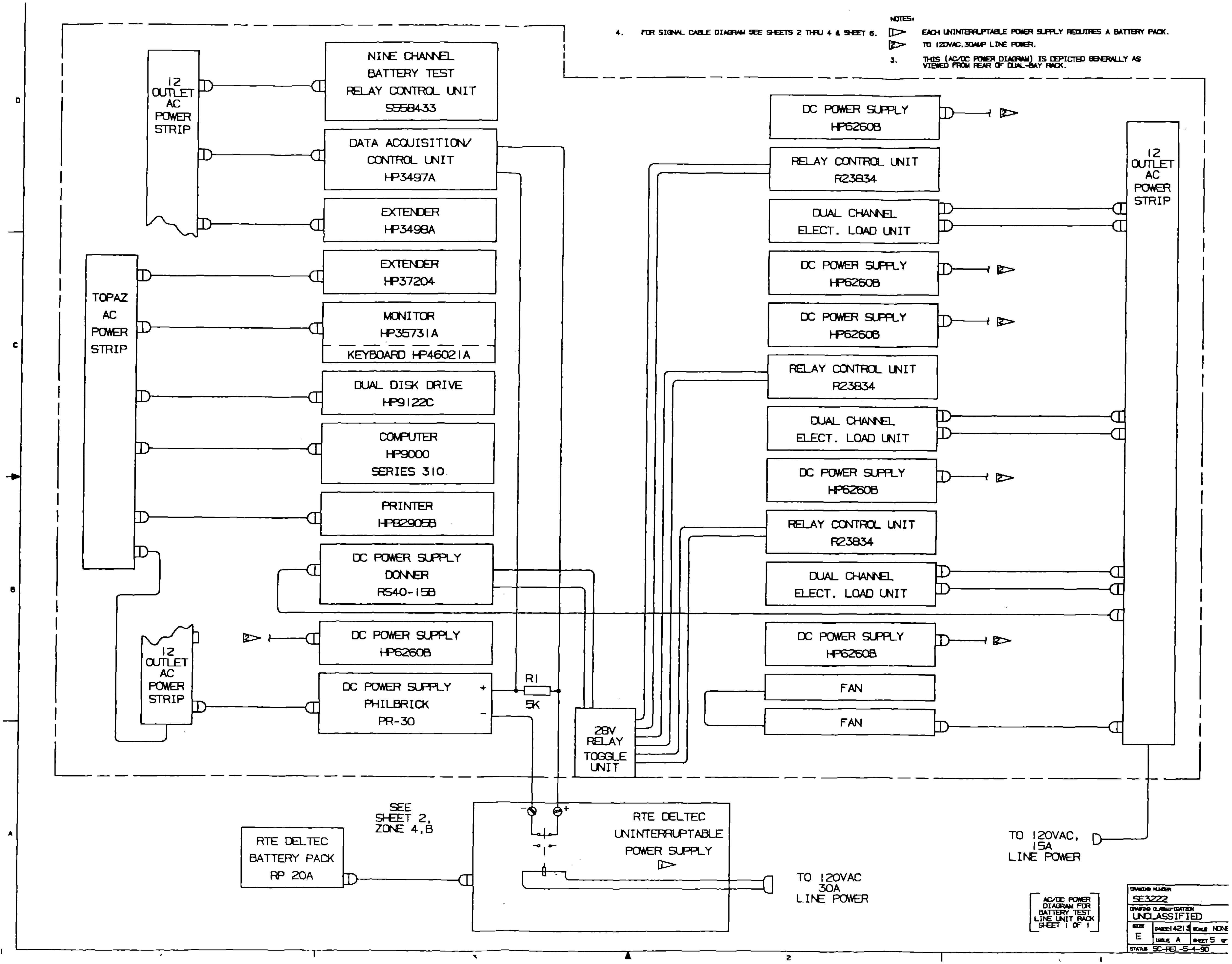
NOTES:

1. CABLE SET (6 PER TEST STATION) TO BE MADE AT TIME OF ASSEMBLY BECAUSE LENGTH REQUIREMENTS ARE EXPECTED TO VARY. FOR DETAILS SEE SHEET 7.
2. REFER TO DRAWING #R23833, SHEET 2.



WIRING DIAGRAM FOR BATTERY TEST LINE UNIT RACK SHEET 3 OF 3

DRAWING NUMBER	SE3222
DRAWING CLASSIFICATION	UNCLASSIFIED
SIZE	E
CAGE	14213
SCALE	NONE
ISSUE	A
SHEET	4 OF
STATUS	SC-REL-5-4-90



NOTES:

4. FOR SIGNAL CABLE DIAGRAM SEE SHEETS 2 THRU 4 & SHEET 6.

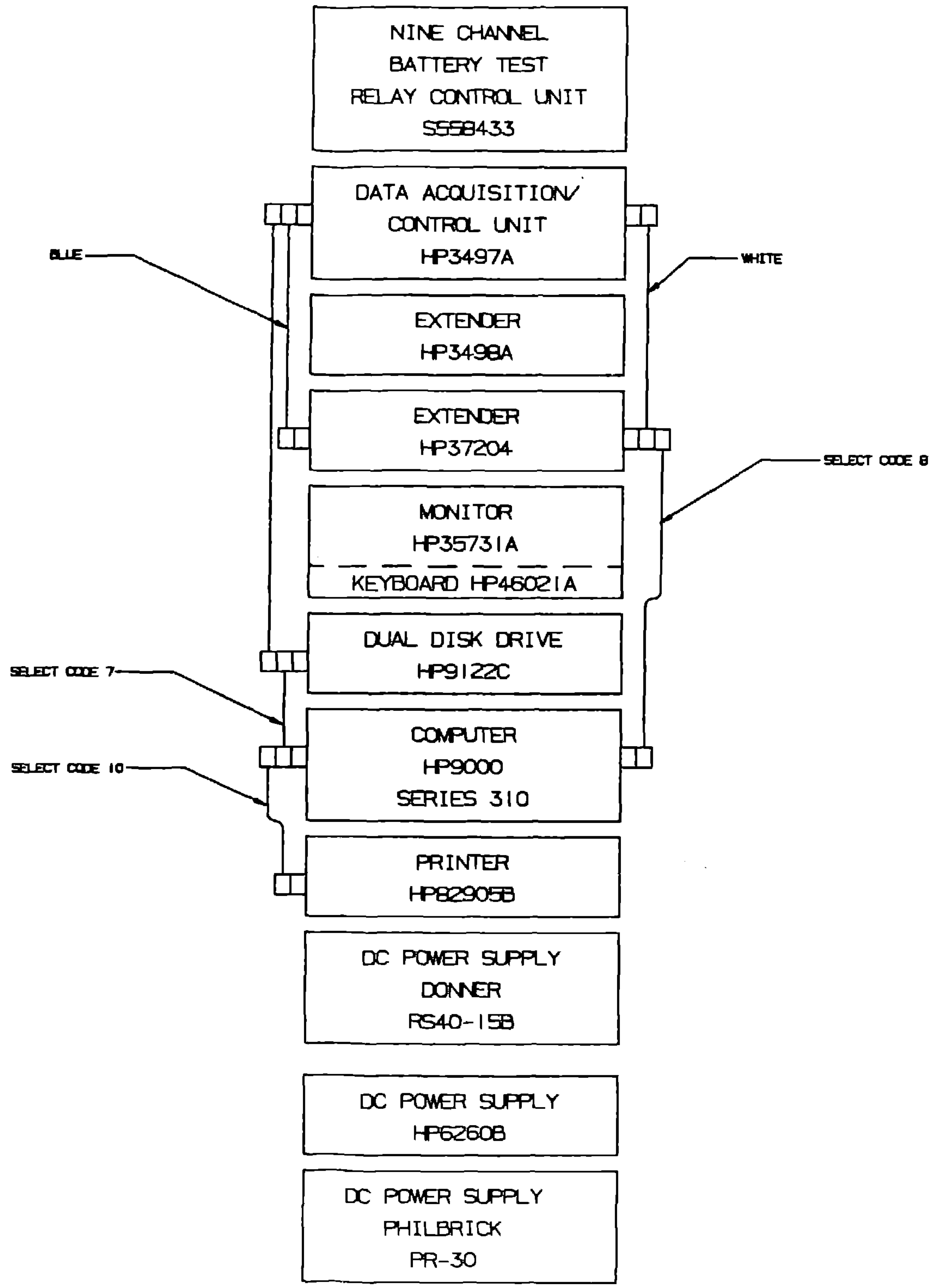
1. EACH UNINTERRUPTABLE POWER SUPPLY REQUIRES A BATTERY PACK.

2. TO 120VAC,30AMP LINE POWER.

3. THIS (AC/DC POWER DIAGRAM) IS DEPICTED GENERALLY AS VIEWED FROM REAR OF DUAL-BAY RACK.

AC/DC POWER DIAGRAM FOR BATTERY TEST LINE UNIT RACK SHEET 1 OF 1

DRAWING NUMBER	SE3222
DRAWING CLASSIFICATION	UNCLASSIFIED
SIZE	E
CAGEC	14213
SCALE	NONE
ISSUE	A
SHEET	5 OF
STATUS	SC-REL-5-4-90

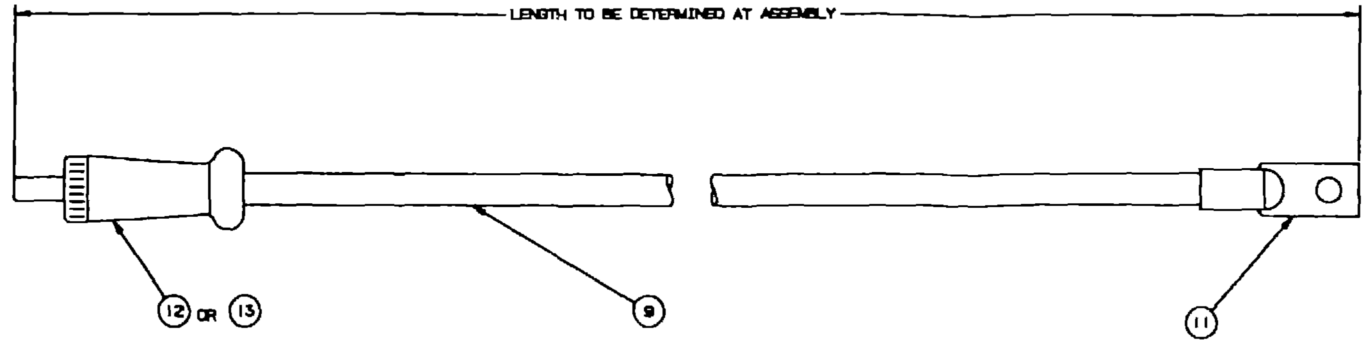


HP-IO DIAGRAM
FOR
BATTERY TEST
LINE UNIT RACK
SHEET 1 OF 1

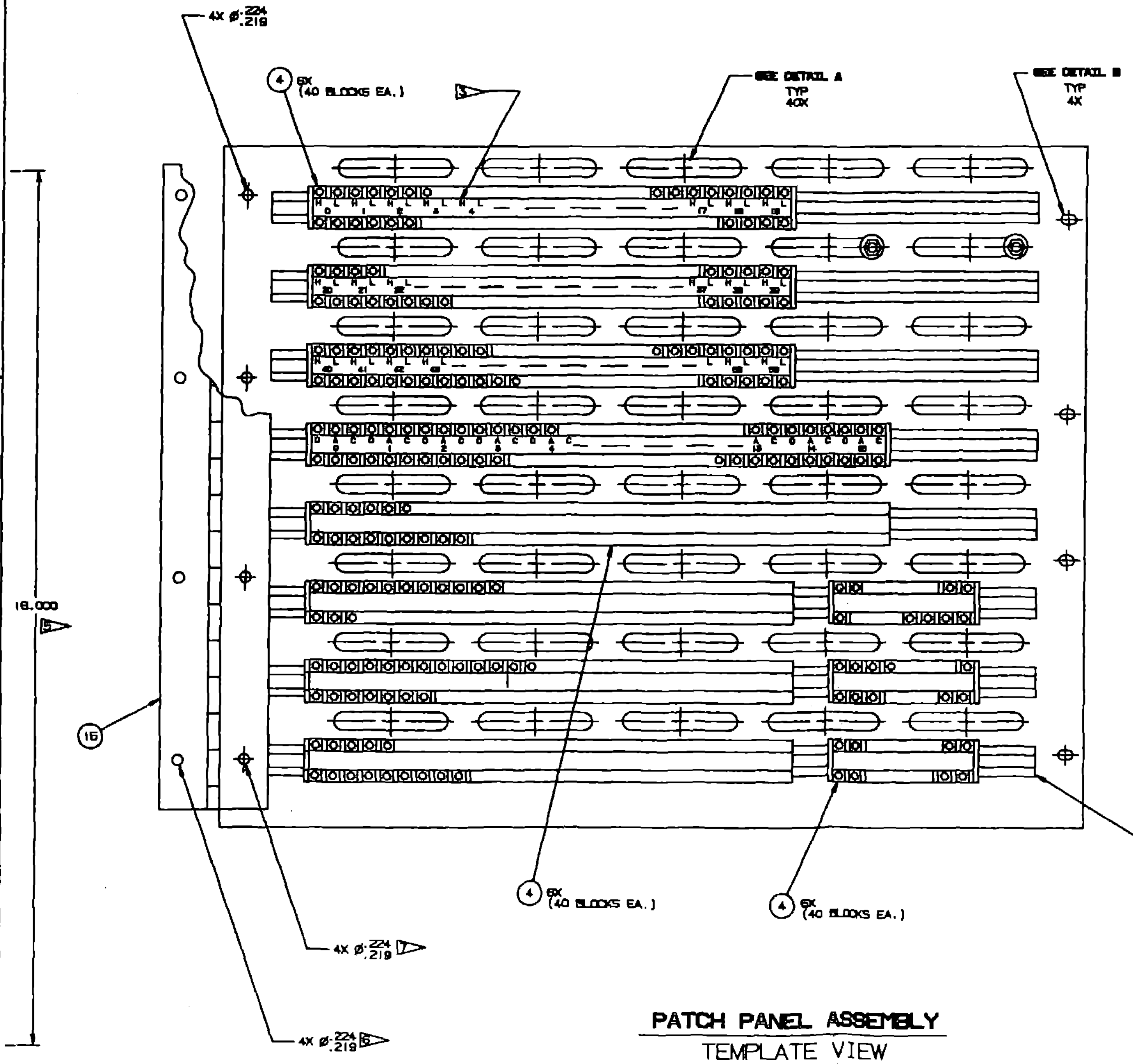
DRAWING NUMBER	SE3222
DRAWING CLASSIFICATION	UNCLASSIFIED
SIZE E	CAGE 14213 / SCALE NONE
	ISSUE A / SHEET 6 OF
STATUS	SC-REL-5-4-90

NOTES:

1. GENERAL REQUIREMENTS PER 9900000.
2. FOR SPECIFIC PROCESSING, MANUFACTURING & ASSEMBLY REQUIREMENTS NOT OTHERWISE COVERED IN THIS DRAWING, SEE 173126.
3. MARK IDENTIFICATION DESIGNATIONS PER 9919100 CLASS A-2 OR A-3, METHOD OPTIONAL, CHARACTER HEIGHT TO BE .100/.200, LOCATE APPROXIMATELY AS SHOWN.
4. BUILD ITEM PER ENGINEER'S INSTRUCTIONS, MOUNT & LOCATE APPROXIMATELY AS SHOWN.
5. USE THIS DIMENSION FOR PRINT INSPECTION ONLY. DO NOT USE PRINTS THAT ARE MORE THAN .100 INCH OUT OF SCALE FOR DRILLING TEMPLATES.
6. MATCH DRILL ITEM 15 TO MOUNT ON VERTICAL MOUNTING ANGLES OF RACK. SEE SHEET 1 FOR APPROXIMATE LOCATION.
7. MATCH DRILL ITEM 15 TO ATTACH TO TEMPLATE DRILLED PANEL.
8. MATCH DRILL ITEM 1 TO MOUNT CHANNELS PER MANUFACTURERS INSTRUCTIONS. LOCATE APPROXIMATELY AS SHOWN.
9. CLEAN AND APPLY ALODINE 1200 FINISH PER MIL-C-5541 TO ALL ALUMINUM SERFACES.

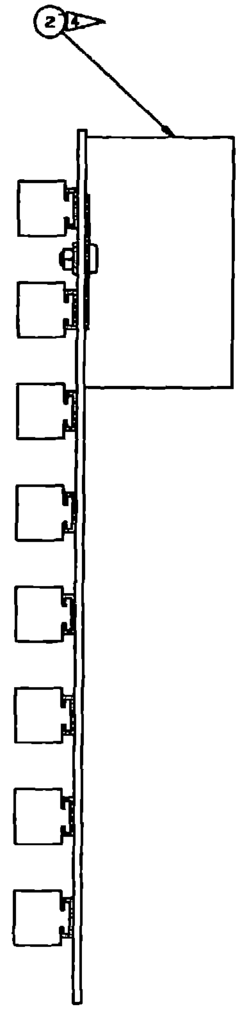


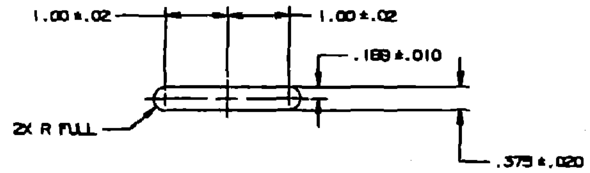
CABLE ASSEMBLY



PATCH PANEL ASSEMBLY

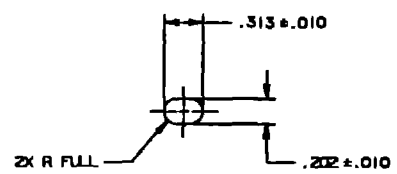
TEMPLATE VIEW





DETAIL A

SCALE 1/1



DETAIL B

SCALE 2/1

NO. REQD	PART/CONTROL NO.	DESCRIPTION/MATERIAL	NOTE	SHEET ZONE	ITEM
1	MS20257	HINGE, CONTINUOUS, 2" x 13.25" LNG			15
					14
1	PS100GR	CONN, ELEC, PLUG, RED, 100A, SE			13
1	PS100GB	CONN, ELEC, PLUG, BLK, 100A, SE			12
1	54109	CONN, ELEC, COMPRESSION, 600V, T&B			11
					10
AR	2(SIZE)	CABLE, WELDING, .49 O.D., DIAMOND			9
					8
					7
					6
AR	130	END SECTION, BUCHANAN			5
488	125	BLOCK, TERMINAL, BUCHANAN			4
8	781789-32002	MOUNT, CH'NL, MIN'TRE, 16" LNG, BUCHANAN			3
1		SWITCH, D/A, 6 CHANNEL	4		2
1	QQ-A-250/11	SHEET, AL., 6061-T6, 18"x14"x.125"			1
NA	9919100	MARKING, GENERAL METHODS			
NA	173126	GEN. SPEC. FOR ACCEPTANCE EQUIP.			
NA	9900000	GENERAL REQUIREMENTS			

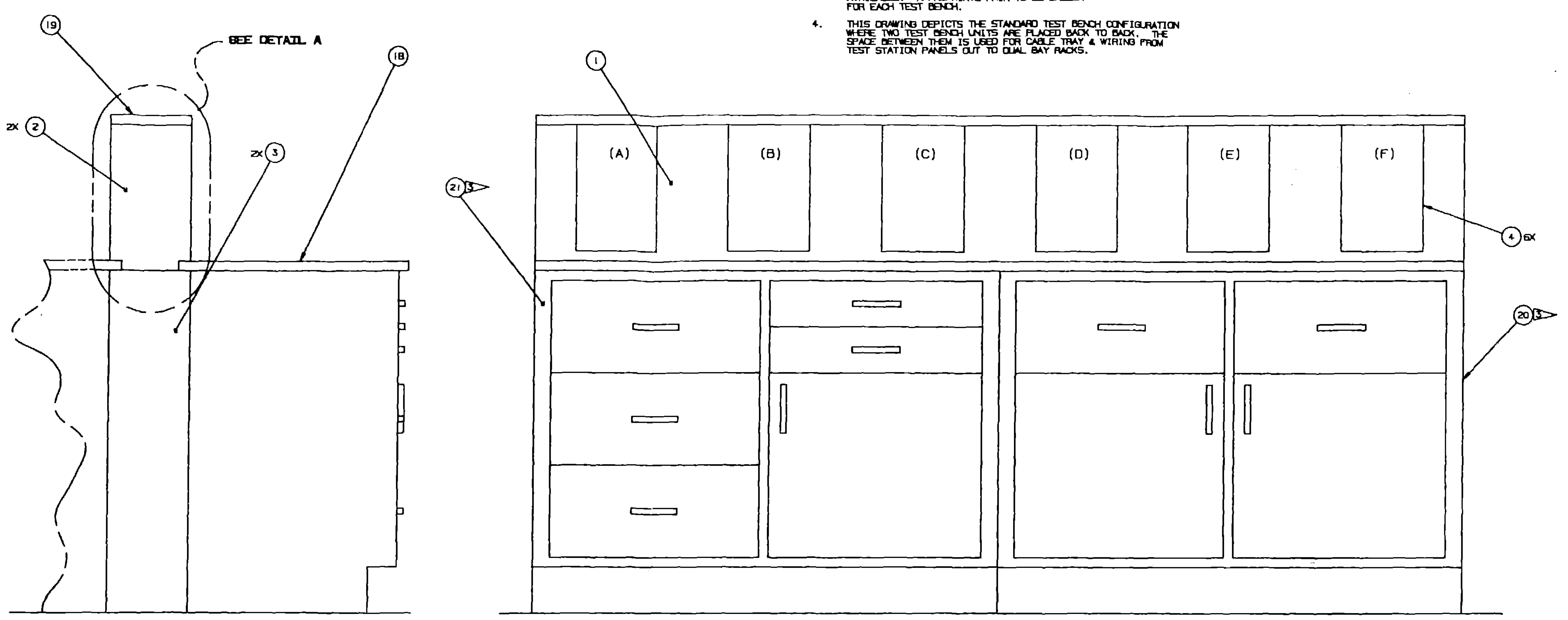
CABLE & PATCH PANEL ASSEMBLIES FOR BATTERY TEST LINE UNIT RACK SHEET 1 OF 1

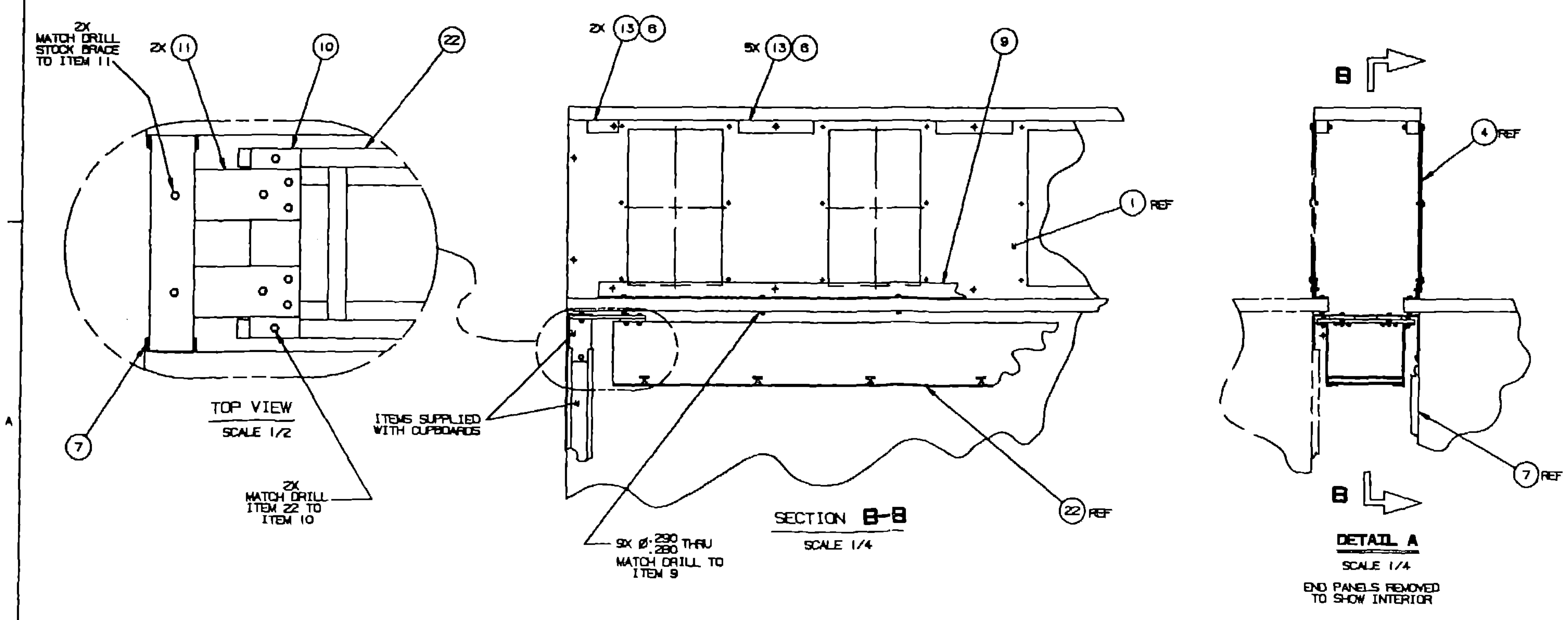
DRAWING NUMBER	SE3222
DRAWING CLASSIFICATION	UNCLASSIFIED
SIZE	E
CAGEC	14213
SCALE	1/1
ISSUE	A
SHEET	7 OF 7
STATUS	SC-REL-5-4-90

NOTES:

1. GENERAL REQUIREMENTS PER 9900000.
2. FOR SPECIFIC PROCESSING, MANUFACTURING & ASSEMBLY REQUIREMENTS NOT OTHERWISE COVERED ON THIS DRAWING, SEE 173128.
3. VARIOUS DRAWER/CUPBOARD CONFIGURATIONS ARE AVAILABLE. APPROPRIATE PAIR TO BE CHOSEN FOR EACH TEST BENCH.
4. THIS DRAWING DEPICTS THE STANDARD TEST BENCH CONFIGURATION WHERE TWO TEST BENCH UNITS ARE PLACED BACK TO BACK. THE SPACE BETWEEN THEM IS USED FOR CABLE TRAY & WIRING FROM TEST STATION PANELS OUT TO DUAL BAY RACKS.

PART NUMBER	REV	SHEET ZONE	PREPARED BY / DESCRIPTION	DATE	CHKR
UA4971-000	A		R.DEVRIES 2850/ G. RODRIGUEZ 2525		





NO. REQD	PART/CONTROL NO.	DESCRIPTION/MATERIAL	NOTE	SHEET ZONE	ITEM
					25
					24
					23
1	5248-066L-12-09	CABLE LADDER, 6" x 4" x 8', COPE			22
1	SE-2048	CABINET, BASE, METAL, KEWAUNEE SCI.			21
1	SE-2158	CABINET, BASE, METAL, KEWAUNEE SCI.			20
1	AS-4908-FT	SHELFTOP, KEMSHIELD, 49"x8"x1"THK, KSC			19
1	AR-4824-FT	BENCHTOP, KEMRESIN, 48"x24"x1"THK, KSC			18
					17
					16
					15
AR		PARTICLE BOARD, 1"THICK.			14
AR		WOOD, GRADE C, 1"x 1"			13
AR	QQ-A-250/4	SHEET, ALUMINUM, 2024-T3, .063THK.			12
AR	QQ-A-225/8	FLAT BAR, ALUMINUM, 6061-T6, .250THK.			11
AR	QQ-A-225/8	FLAT BAR, ALUMINUM, 6061-T6, .250 THK.			10
AR	QQ-A-200/16	ANGLE, ALUMINUM, 6061-T6511, .125 THK.			9
AR	QQ-A-250/11	SHEET, ALUMINUM, 6061-T6, .125 THK.			8
AR		ADHEASIVE, TAPE, TWO-SIDED			7
AR		ADHEASIVE, EPOXY			6
					5
6		PANEL, BATTERY TEST STATION			4
2		END PANEL, LOWER			3
2		END PANEL, UPPER			2
1		MOUNTING PANEL			1
NA	173128	GENERAL SPEC. FOR ACCEPTANCE EQUIPT.			
NA	9900000	GENERAL REQUIREMENTS			

TEST BENCH ASSY & DETAILS SHEET 1 OF 2

SHEET	1	2	3	4	5	6
ISSUE	A	A	A			

TITLE (U) TITLE CLASSIFICATION

BATTERY TEST BENCH

PART CLASSIFICATION: UNCLASSIFIED

DRAWING CLASSIFICATION: UNCLASSIFIED

SIZE: E DRAWING NUMBER: UA4971

CAGEC 14213 SCALE 1/4 SHEET 1 OF

STATUS SC-REL-5-4-90 ORGN SC-AN5-V1.2

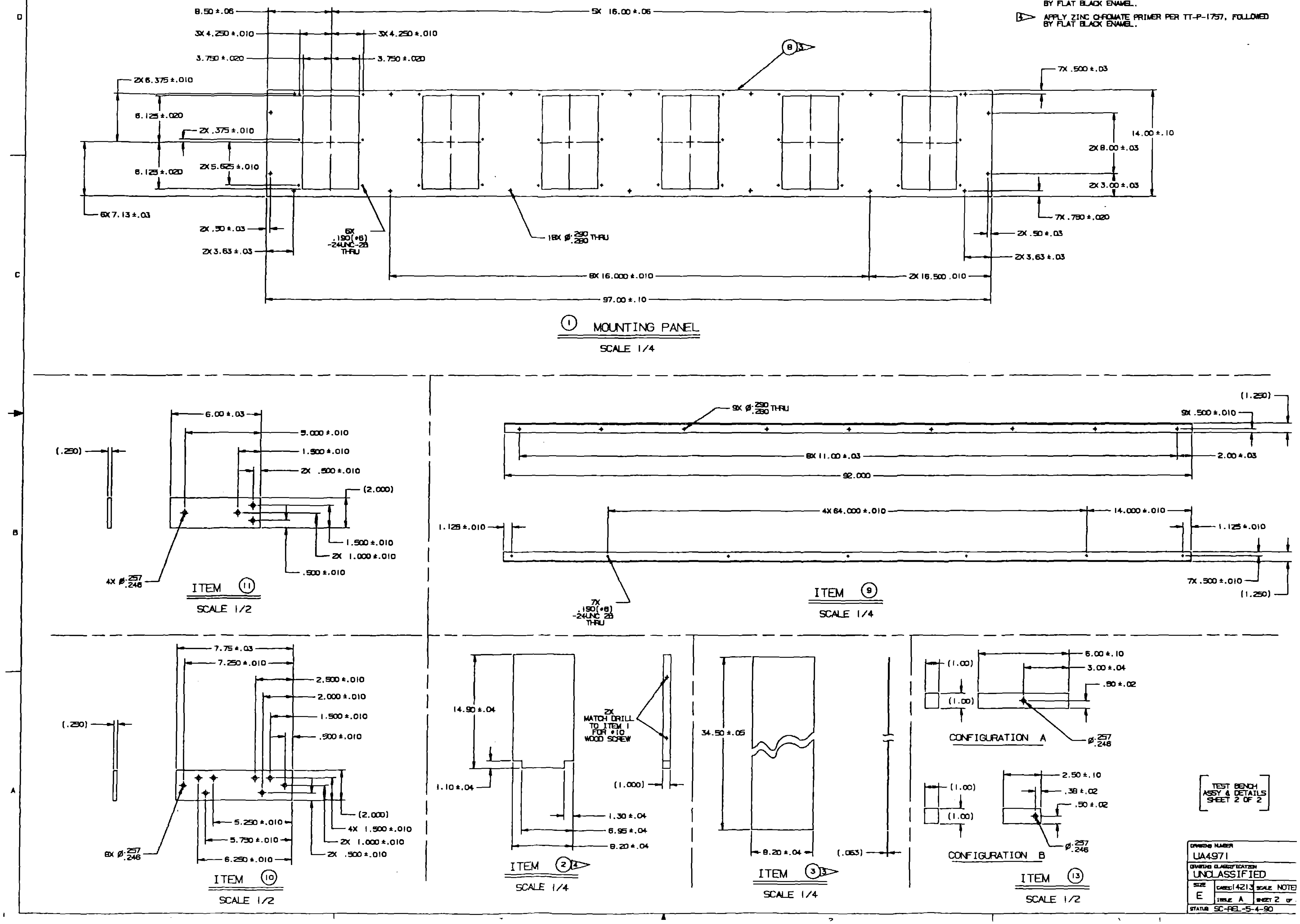
NOTES:

1. GENERAL REQUIREMENTS PER 9900000.

2. FOR SPECIFIC PROCESSING, MANUFACTURING AND ASSEMBLY REQUIREMENTS NOT OTHERWISE COVERED ON THIS DRAWING, SEE 173126.

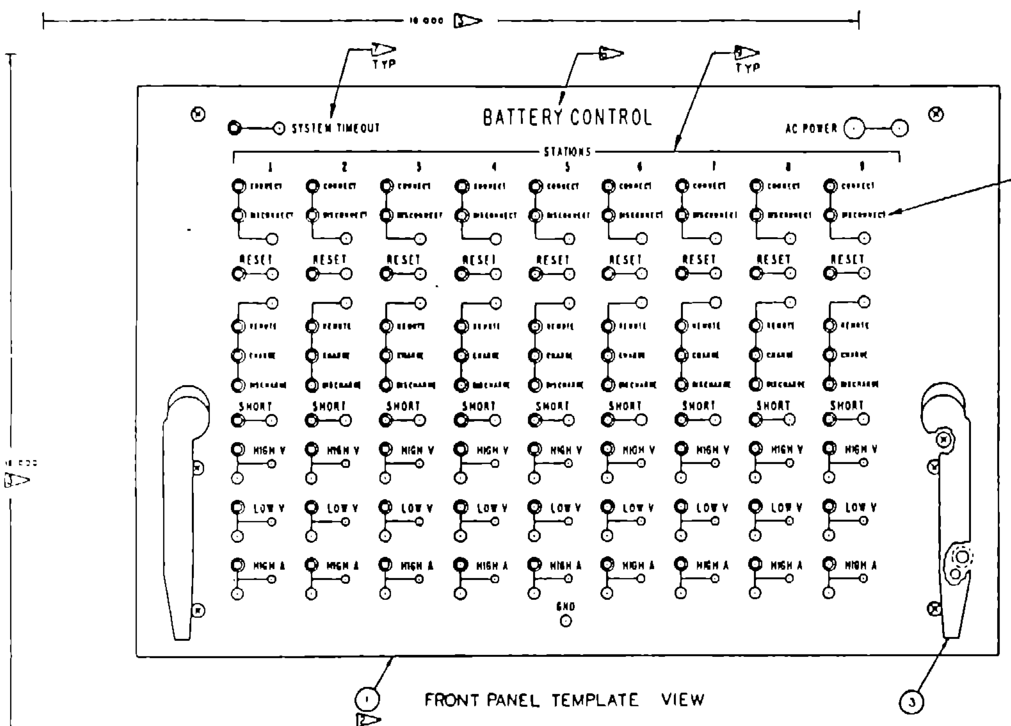
3 CLEAN AND APPLY ALODINE 1200 FINISH PER MIL-C-5541, APPLY ZINC CHROMATE PRIMER PER TT-P-1757, FOLLOWED BY FLAT BLACK ENAMEL.

4 APPLY ZINC CHROMATE PRIMER PER TT-P-1757, FOLLOWED BY FLAT BLACK ENAMEL.

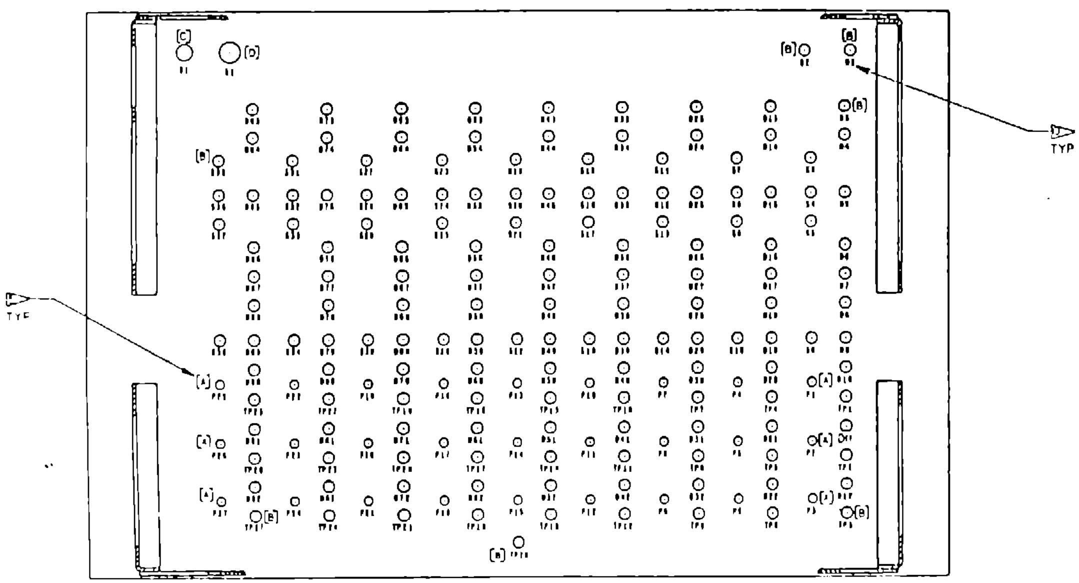


TEST BENCH ASSY & DETAILS SHEET 2 OF 2

DRAWING NUMBER	UA4971	
DRAWING CLASSIFICATION	UNCLASSIFIED	
SIZE E	CAGEC 14213	SCALE NOTED
	ISSUE A	SHEET 2 OF
STATUS	SC-REL-5-4-90	



FRONT PANEL TEMPLATE VIEW



REAR VIEW OF FRONT PANEL

NOTES :

1. FOR SPECIFIC PROCESSING, MANUFACTURING AND ASSEMBLY REQUIREMENTS NOT OTHERWISE COVERED ON THIS DRAWING, SEE 173126.

2. COMPONENTS NOT IDENTIFIED BY ITEM NUMBERS ON THE ASSEMBLY ARE LOCATED IN THE LIST OF MATERIAL BY REFERENCE DESIGNATIONS.

3. USE THIS DIMENSION FOR PRINT INSPECTION MEASUREMENT ONLY. DO NOT USE PRINTS MORE THAN .100 INCH OUT-OF SCALE FOR DRILLING TEMPLATES.

4. REFERENCE DESIGNATIONS APPEARING WITHIN A DOTTED RECTANGLE ARE TO BE MARKED ON OPPOSITE SIDE.

5. DO NOT MARK DESIGNATIONS APPEARING IN BRACKETS AND DIMENSIONS APPEARING WITHIN OUTLINE OF VIEWS ON THE UNIT.

6. ENGRAVE .320/.312 INCH HIGH CONDENSED CHARACTERS, GROOVE WIDTH .030/.025 INCH WIDE, BLACK FILLER, LOCATE APPROXIMATELY AS SHOWN.

7. ENGRAVE .201/.187 INCH HIGH CONDENSED CHARACTERS, GROOVE WIDTH .030/.025 INCH WIDE, BLACK FILLER, LOCATE APPROXIMATELY AS SHOWN.

8. ENGRAVE .140/.125 INCH HIGH CONDENSED CHARACTERS, GROOVE WIDTH .020/.015 INCH WIDE, BLACK FILLER, LOCATE APPROXIMATELY AS SHOWN.

9. ENGRAVE LINES .025/.020 WIDE, BLACK FILLER, ITEM 22. LOCATE APPROXIMATELY AS SHOWN.

10. MARK (WITH COVER COAT) REFERENCE DESIGNATIONS .125-INCH BLACK CHARACTERS. LOCATE APPROXIMATELY AS SHOWN.

11. MARK LINES .030/.025 WIDE, BLACK FILLER, ITEM 22. LOCATE APPROXIMATELY AS SHOWN. METHOD OPTIONAL.

12. CLEAN AND APPLY ALODINE 1200 FINISH PER MIL-C-5541 AND PRIMER ZINC CHROMATE PER TT-P-1757, FOLLOWED BY ENAMEL, MINT GRAY HP6010-0331 (ITEM 25).

13. MODIFY CARD RACK (ITEM 5) TO DIMENSION 10.563 FOR SIX BARS HAVING SLOT FOR TEN CARDS.

14. MATCH, DRILL HOLES LABELED "L" 4 PLACES AT ASSEMBLY.

HOLE TABLE			
SYM	DESCRIPTION	REQ'D	HOW
A	Ø .210/.200	27	—
B	Ø .255/.250	156	—
C	Ø .390/.380	1	—
D	Ø .475/.470	1	—

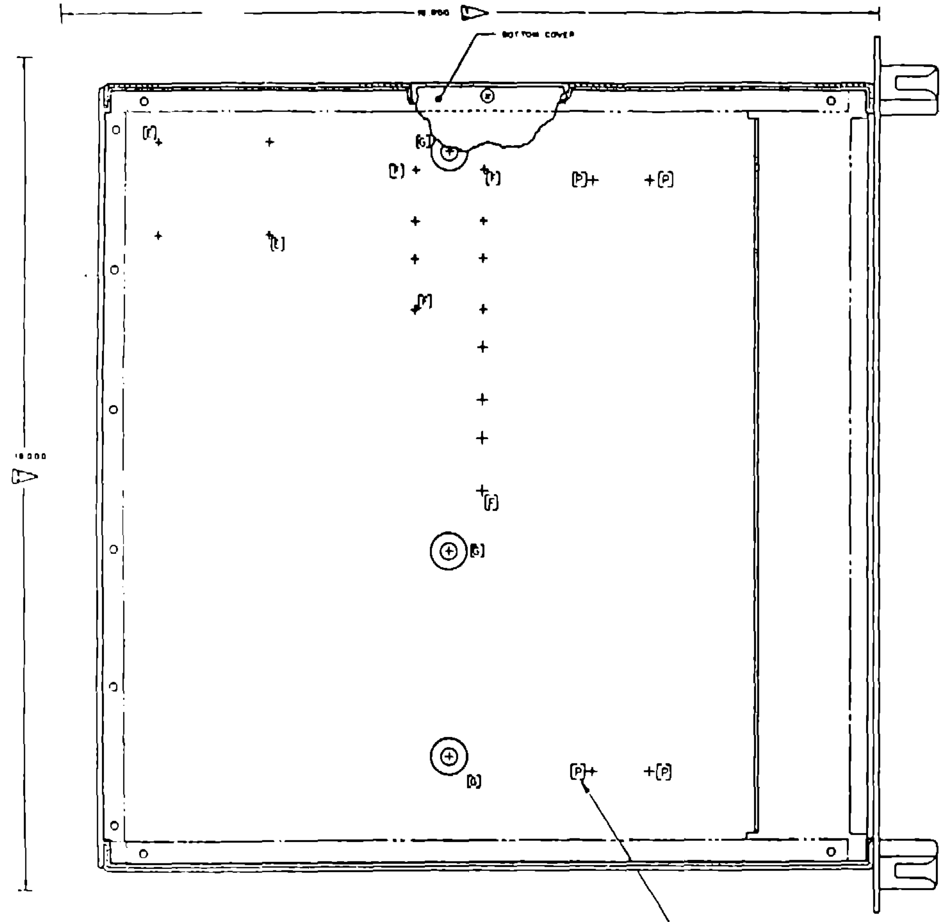
QTY	PART NO.	DESCRIPTION				ITEM
1	341001	FUSEHOLDER LITTLEFUSE (00172)			XF1	
1	105-0603-001	JACK, TIP (BLACK) E.F. JOHNSON (83184 0)			TP21	
22	105-0602-001	JACK, TIP (RED) E.F. JOHNSON (83184 0)		TP1	TP22	
1	750-11-06-001	TERMINAL BOARD CINCH DIV (12355)			TB1	
9	8867K1	SWITCH, TOGGLE, (MS24654-211) CUTLER-HAMMER (05M79)	S3	S6	S11	
			S15	S21	S35	
			S19	S33	S37	
9	173	SWITCH, PUSH (RED) SWITCHCRAFT (GREEN)	S4	S8	S13	
			S16	S20	S24	
			S28	S32	S36	
19	8866K1	SWITCH, TOGGLE (MS24655-221) CUTLER-HAMMER (05M79)	S2	S5	S6	
			S7	S10	S11	
			S14	S11	S18	
			S15	S12	S12	
			S16	S27	S30	
			S31	S34	S29	
			S30			
1	MS25306-222	SWITCH, TOGGLE (81349)			S1	
AR		VARIABLE, RESISTOR (05M51)		R1-	R21	
1	LOS-V-18	POWER SUPPLY LAMBDA (19084)			PS2	
1	316C, A	POWER SUPPLY POWER GENERAL NO. (61913)			PS1	
1	6EF1	FILTER, LINE, RECEP. CORCON INC. (03312)			J11	
10	MP-0125-030-0W-5	CONN. RECEP. ELECT.		J1-	J10	
1	MDX-5	FUSE, CARTRIDGE BUSSMAN (71400)			F1	
21	5082-4880	DIODE, LIGHT EMITTING (RED) HEWLETT-PACKARD (50434)		D1	D21	
1	269-1M1-0935-94	LIGHT, INDICATOR (YELLOW) DIALIGHT CORP. (60079)			DS1	
						26
EM	HP6010-0331	ENAMEL, BAKING, MINT GRAY H-P (28480)				25
						24
						23
EM	751-BLK	ENAMEL, ENGRAVERS NEW HERMES (61062)				22
						21
						20
AR		WIRE, BARE (BUS) #22 AWG				19
						18
EE	L-P-410	POLYAMIDE, MOLYBDENUM INSULATION VAR INK				17
						16
						15
3	83	GROMMET, RUBBER RUBATEX (SE1004)				14
12	715	TERMINAL, STUD USECO DIV. (83330)				13
4	2121	SPACER, SLEEVE H.H. SMITH (83330)				12
						11
6	453-12-8-012	TERMINAL, LUG SERIES 554 CINCH DIV (83330)				10
						9
						8
						7
						6
1	SCF-16-1.00-17.0	CARD FILES, SERIES 5, STANDARD LOGIC				5
						4
1	HO-18	HANDLE SET, DOOR ZERO (11444)				3
						2
1	BMM 1758	CHASSIS, ELECT. EQUIP., 12.25 X 17, ZERO (11444)				1
NA	173126	GENERAL SPECS. FOR ACCEPTANCE EQUIPMENT				
NA	8400000	GENERAL REQUIREMENTS				

LIST OF MATERIAL

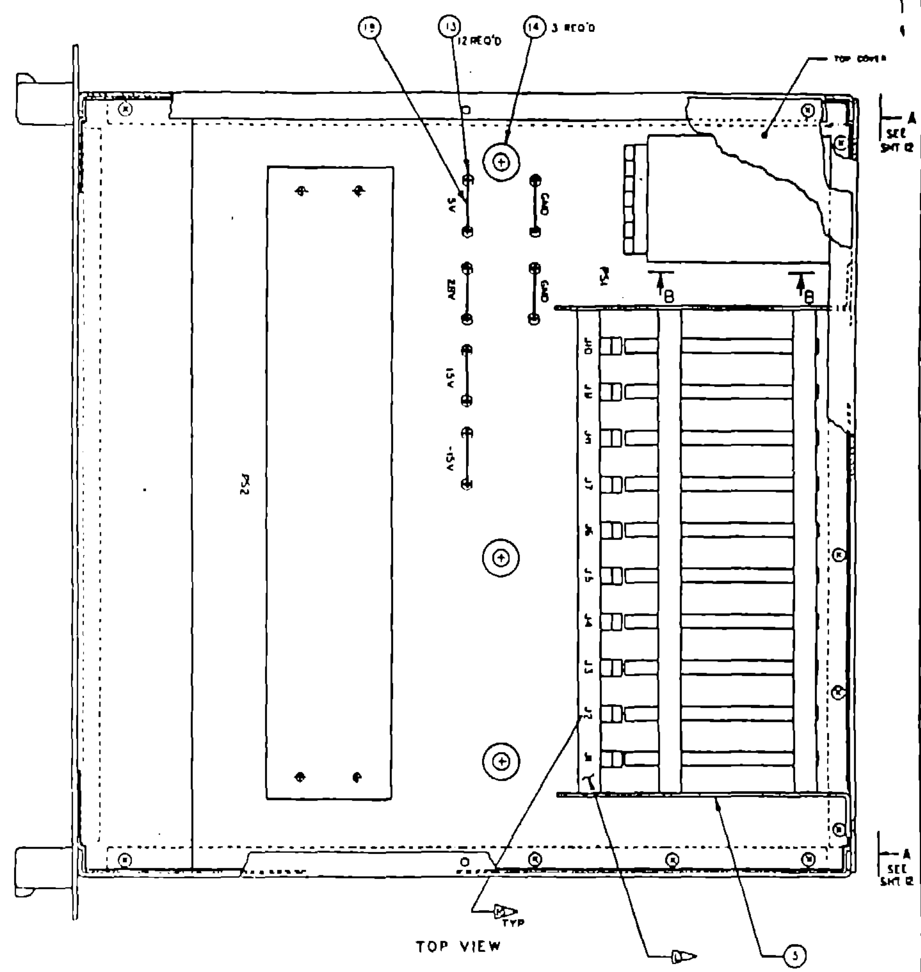
MECHANCIAL FOR
BATTERY TEST RELAY BOX
SHEET 1 OF 3

UNCLASSIFIED

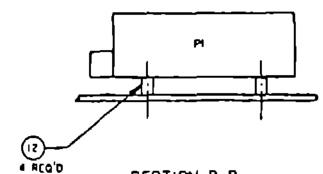
E 14213 S53433



BOTTOM TEMPLATE VIEW



TOP VIEW



SECTION B-B

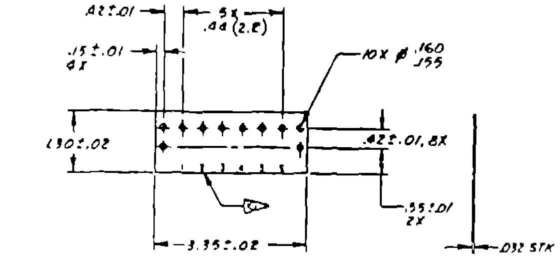
HOLE TABLE			
SYM	DESCRIPTION	REQ'D	HDW
E	Ø.152/.147	4	4-40
F	Ø.186/.180	12	6-32
G	Ø.375/.562	3	—
P	Ø.228/.221	4	10-32

CHANGES TO TEMPLATE VIEWS
MUST BE MADE TO SCALE

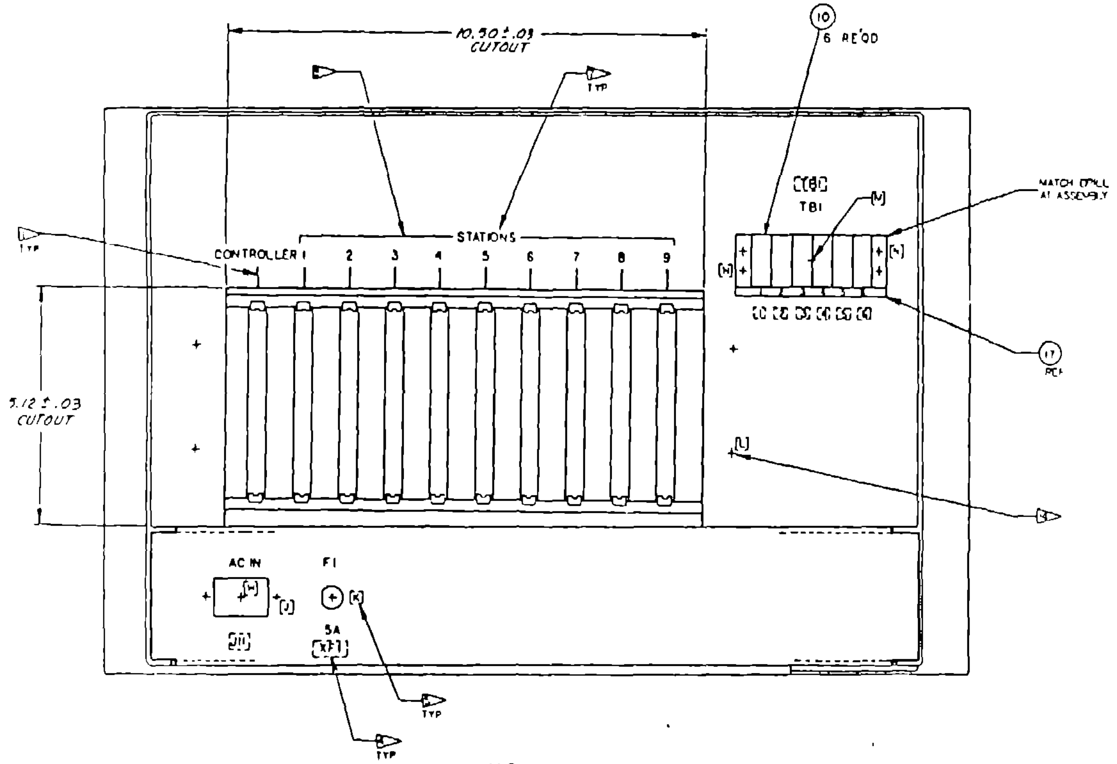
MECHANICAL FOR
BATTERY TEST RELAY BOX
SHEET 2 OF 3

UNCLASSIFIED

14213 | 55A433



ITEM 17



VIEW A-A
REAR TEMPLATE VIEW
ROTATED 90° CLOCKWISE
(FROM SHEET 11)

HOLE TABLE			
SYM	DESCRIPTION	REQD	HOW
H	[illegible] CUTOUT	1	—
J	⌀ .152/.147	2	4-40
K	SEE FIG. C	1	—
L	⌀ .390/.375	4	10-32
M	.750 x 2.562 CUTOUT	1	—
N	⌀ .86/.80	4	6-32

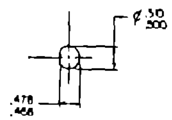


FIG. C

CHANGES TO TEMPLATE VIEW
MUST BE MADE TO SCALE

MECHANICAL FOR
BATTERY TEST RELAY BOX
SHEET 3 OF 3

A

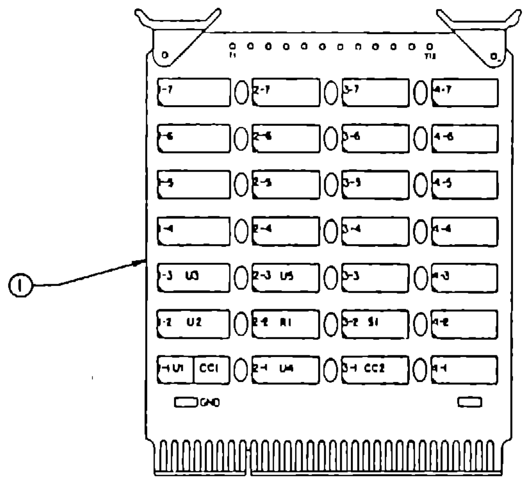
UNCLASSIFIED

E 14213 S52433

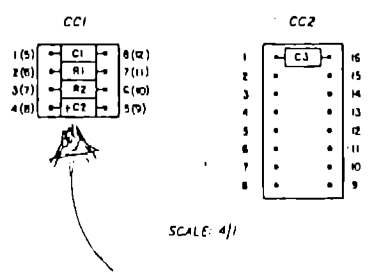
SCALE 1/1

NOTES:

1. FOR SPECIFIC PROCESSING, MANUFACTURING, AND ASSEMBLY REQUIREMENTS NOT OTHERWISE COVERED ON THIS DRAWING, SEE 173174.



TOP VIEW
COMPONENT SIDE



SCALE: 4/1

1	SN74S[illegible]	I.C., 14 PINS, TEXAS INSTR. [illegible]			U5
1	SN74S[illegible]	I.C., 14 PINS, TEXAS INSTR. [illegible]			U4
1	SN74S[illegible]	I.C., 14 PINS, TEXAS INSTR. [illegible]			U3
1	SN74S[illegible]	I.C., 14 PINS, TEXAS INSTR. [illegible]			U2
1	ICM7555IPA	I.C., 8 PINS, INTERSIL [illegible]			U1
1	[illegible]	SWITCH, ROCKER, 1 PIN, GRAYHILL [illegible]			S1
1	[illegible]	RESISTOR NETWORK, [illegible], +/- [illegible],			R3
		ALLEN-BRADLEY [illegible]			
1	[illegible]	RESISTOR, FIXED, FILM, [illegible], +/- [illegible]			R2
		[illegible]			
1	[illegible]	RESISTOR, FIXED, COMP., [illegible], +/- [illegible]			R1
		[illegible]			
1	[illegible]-CC1	ADAPTER PLUG, 16 PINS, AUGAT [illegible]			CC2
1	[illegible]-CC1	ADAPTER PLUG, 8 PINS, AUGAT [illegible]			CC1
1		CAPACITOR, ELEC., [illegible], [illegible], +/- [illegible]			C2
		[illegible]			
2	[illegible]	CAPACITOR, FIXED, CERAMIC, .1UF, [illegible],		C1,	C3
		+/- [illegible] [illegible]			
					7
					6
					5
					4
AR	[illegible]	WIRE, ELECT., AWG [illegible] [illegible]			3
					2
1	[illegible]	PRINTED WIRING BD., STANDARD LOGIC			1
NA	173174	GENERAL SPECS. FOR ACCEP. EQUIP.			

SYSTEM CONTROLLER
BOARD CARD
SHEET 1 OF 1

A

UNCLASSIFIED

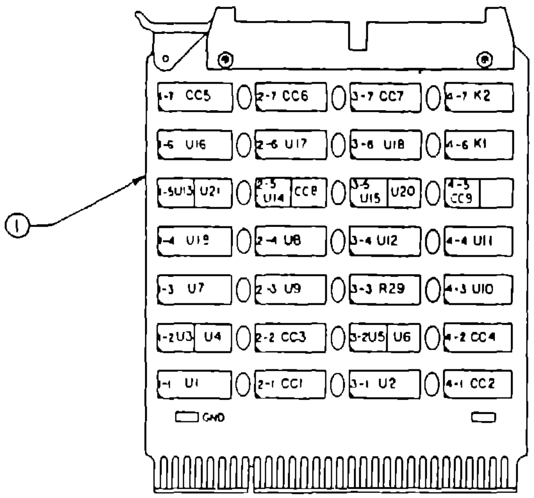
E 14213 558433

2/1 B [illegible]

BATTERY CONTROLLER CARD

NOTES:

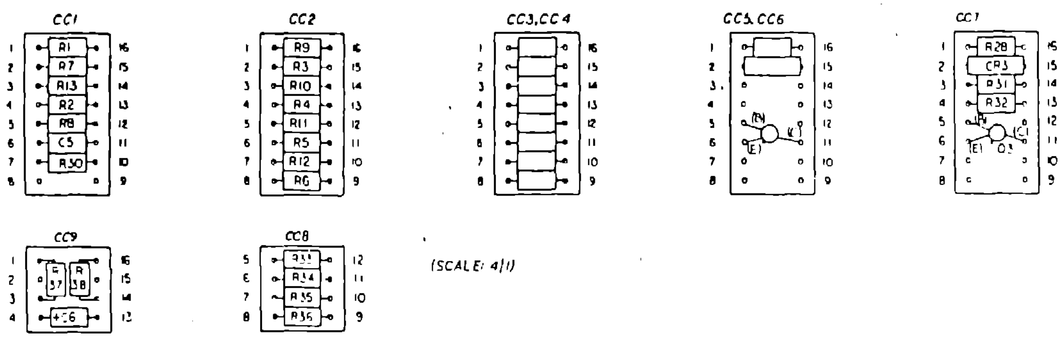
1. FOR SPECIFIC PROCESSING, MANUFACTURING AND ASSEMBLY REQUIREMENTS NOT OTHERWISE COVERED ON THIS DRAWING, SEE 173176.



TOP VIEW
COMPONENT SIDE
(SCALE: 2/1)

FOR COMPONENT IDENTIFICATION OF CC3-CC7 SEE TABLE BELOW:

PINS	CC3	CC4	CC5	CC6
1,16	R14	R16	R25	R27
2,15	R18	R20	CR1	CR2
3,14	R22	R24		
4,13	C2	C3		
5,12	R15	R17	Q1	Q2
6,11	R19	R21		
7,10	R23	R25		
8,9	C1	C4		



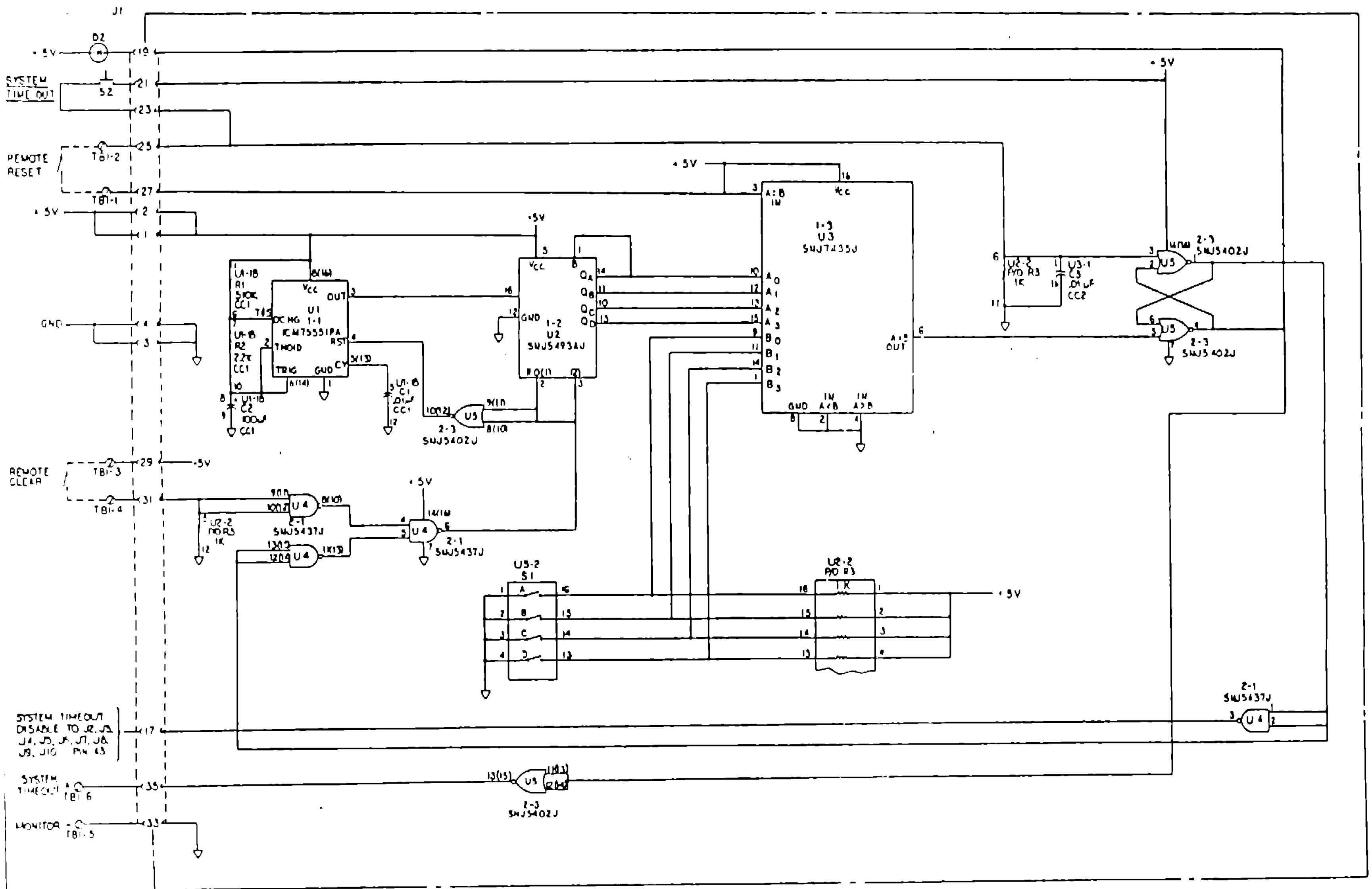
(SCALE: 4/1)

2	HCPL-2731	I.C., 8 PINS, HEWLETT-PACKARD (643345)		U20-	U21
1	SN75492N	I.C., 14 PINS, TEXAS INSTRUMENTS (632371)			U19
3	DM8072[illegible]	I.C., 16 PINS, NATIONAL SEMICONDUCTOR [illegible]		U16-	U18
3	MCA[illegible]	I.C., 6 PINS, MONSANTO ([illegible])		U13	U15
1	SN[illegible]	I.C., 14 PINS, TEXAS INSTR. ([illegible])			U12
3	SN[illegible]	I.C., 14 PINS, TEXAS INSTR. ([illegible])		U9-	U11
2	SN[illegible]	I.C., 14 PINS, TEXAS INSTR. ([illegible])		U[illegible]	U8
4	CA[illegible]	I.C., 8 PINS, RCA ([illegible])		U3 -	U6
2	[illegible]	I.C., 14 PINS, TEXAS INSTR. ([illegible])		U1,	U2
4	RLR07C[illegible]	RESISTOR, FIXED, FILM, [illegible] (440018-[illegible])		R33-	R36
1	RLR07C[illegible]	RESISTOR, FIXED, FILM, [illegible] (440018-[illegible])			R31
1	[illegible]	RESISTOR NETWORK, [illegible] OHMS			R29
		ALLEN BRADLEY ([illegible])			
3	RLR07C[illegible]	RESISTOR, FIXED, FILM, [illegible]		R26-	R28
		(440018-[illegible])			
2	RLR07C[illegible]	RESISTOR, FIXED, FILM, [illegible]		R22-	R23
		(440018-[illegible])			
8	RLR07C[illegible]	RESISTOR, FIXED, FILM, [illegible]		R1[illegible]-	R[illegible]
		(440018-[illegible])			R30
4	RLR07C[illegible]	RESISTOR, FIXED, FILM, [illegible]		R14-	R17
		(440018-[illegible])			
4	RLR07C[illegible]	RESISTOR, FIXED, FILM, [illegible]		R32,	R[illegible]
		(440018-[illegible])		R37	R38
6	RLR07C[illegible]	RESISTOR, FIXED, FILM, [illegible]		R7 -	R12
		(440018-[illegible])			
6	RLR07C[illegible]	RESISTOR, FIXED, FILM, [illegible]		R1-	R6
		(440018-[illegible])			
3	2N2222A	TRANSISTOR ([illegible])		Q1-	Q3
2	[illegible]	RELAY, REED, 14 PIN, [illegible], CLARE ([illegible])		K1,	K2
3	[illegible]	SEMICONDUCTOR DEVICE, DIODE ([illegible])		CR1-	CR3
2	608-CGL	ADAPTER PLUG, 8-PINS, AUGAT (632230)		CC8,	CC9
7	616-CG1	ADAPTER PLUG, 16-PINS, AUGAT (633[illegible])			CC7
5	[illegible]	CAPACITOR, FIXED, CERAMIC, [illegible]	C5	C1-	C4
		(440025-[illegible])			
1	[illegible]	CAPACITOR, FIXED, CERAMIC, 4.7UF, [illegible]			C6
		(440035-204)			
					5
					4
AR	[illegible]	WIRE, [illegible], AWG [illegible] ([illegible])			3
					2
1		PRINTED WIRING BD., STANDARD LOGIC			1
NA	173176	GENERAL SPECS FOR ACCEP. EQUIP.			

ALARM CONTROL CARD
SHEET 1 OF 1

UNCLASSIFIED

NOTES:
1. PIN NUMBERS NOT IN PARENTHESIS ARE THAT OF THE I.C.
2. PIN NUMBERS IN PARENTHESIS ARE THAT OF THE SOCKET.

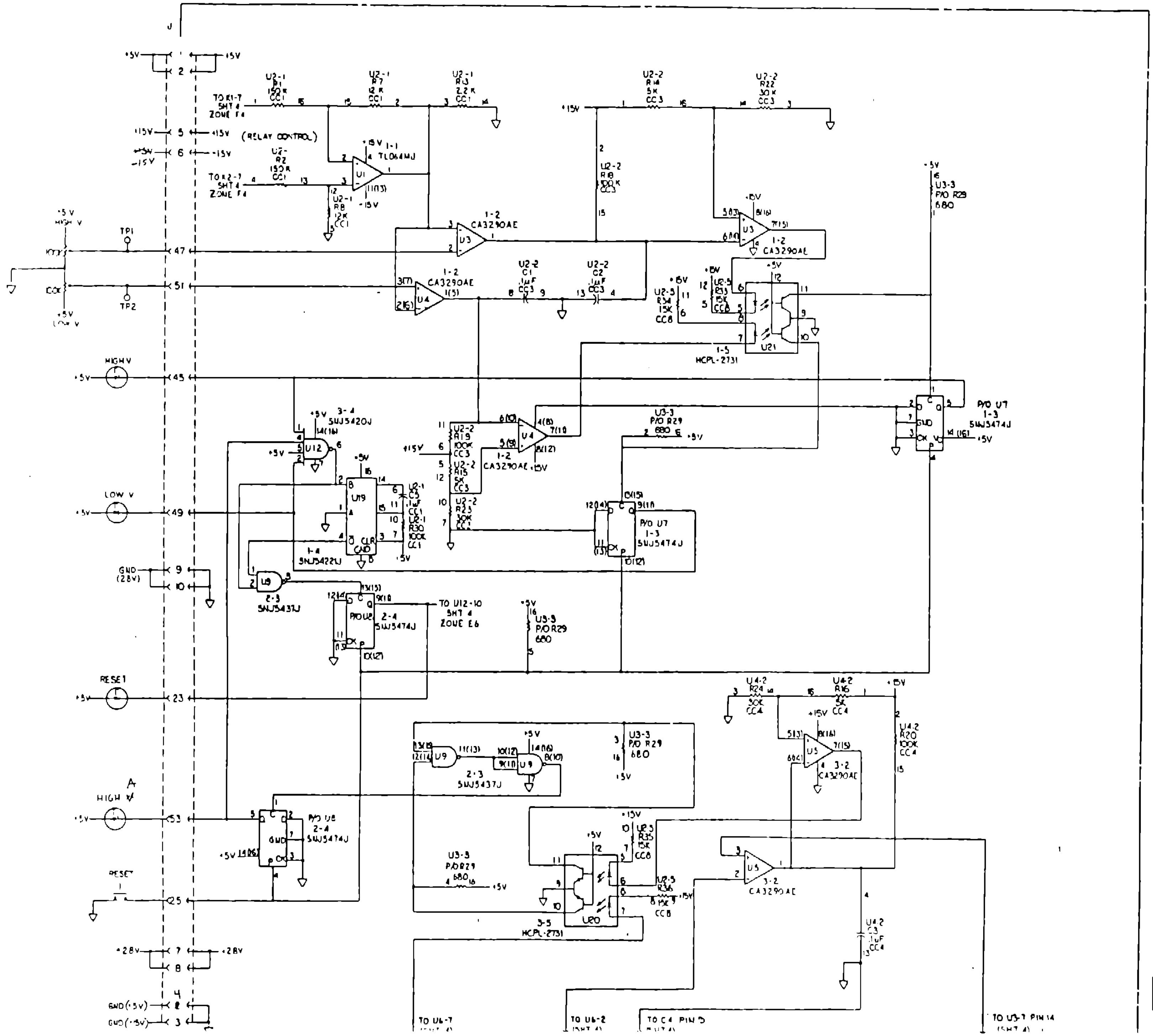


SCHEMATIC SYSTEM CONTROLLER BOARD SHT 1 OF 1

UNCLASSIFIED

NOTES:

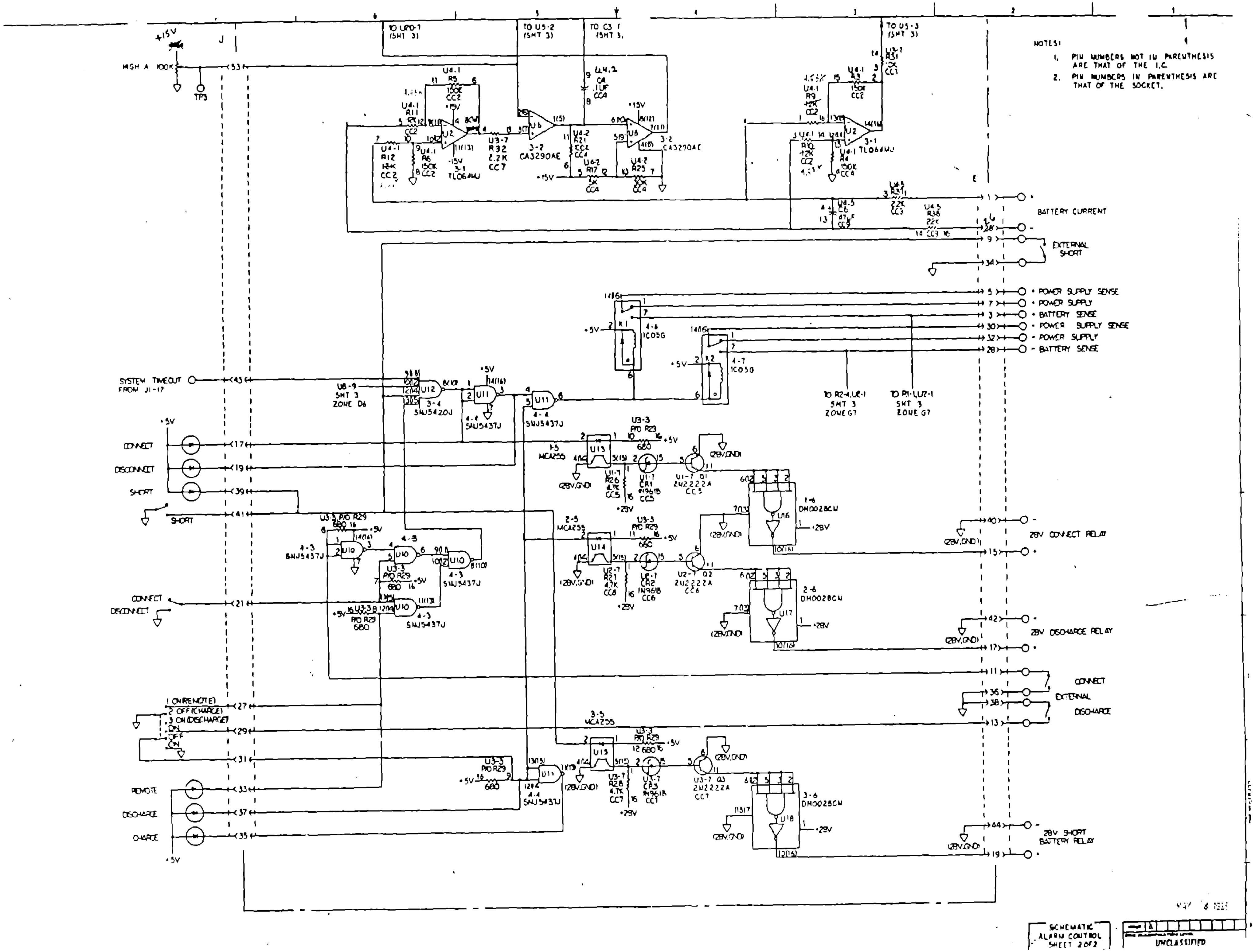
1. PIN NUMBERS PARENTHESIS ARE THAT OF THE I.C.
2. PIN NUMBERS IN PARENTHESIS ARE THAT OF THE SOCKET.



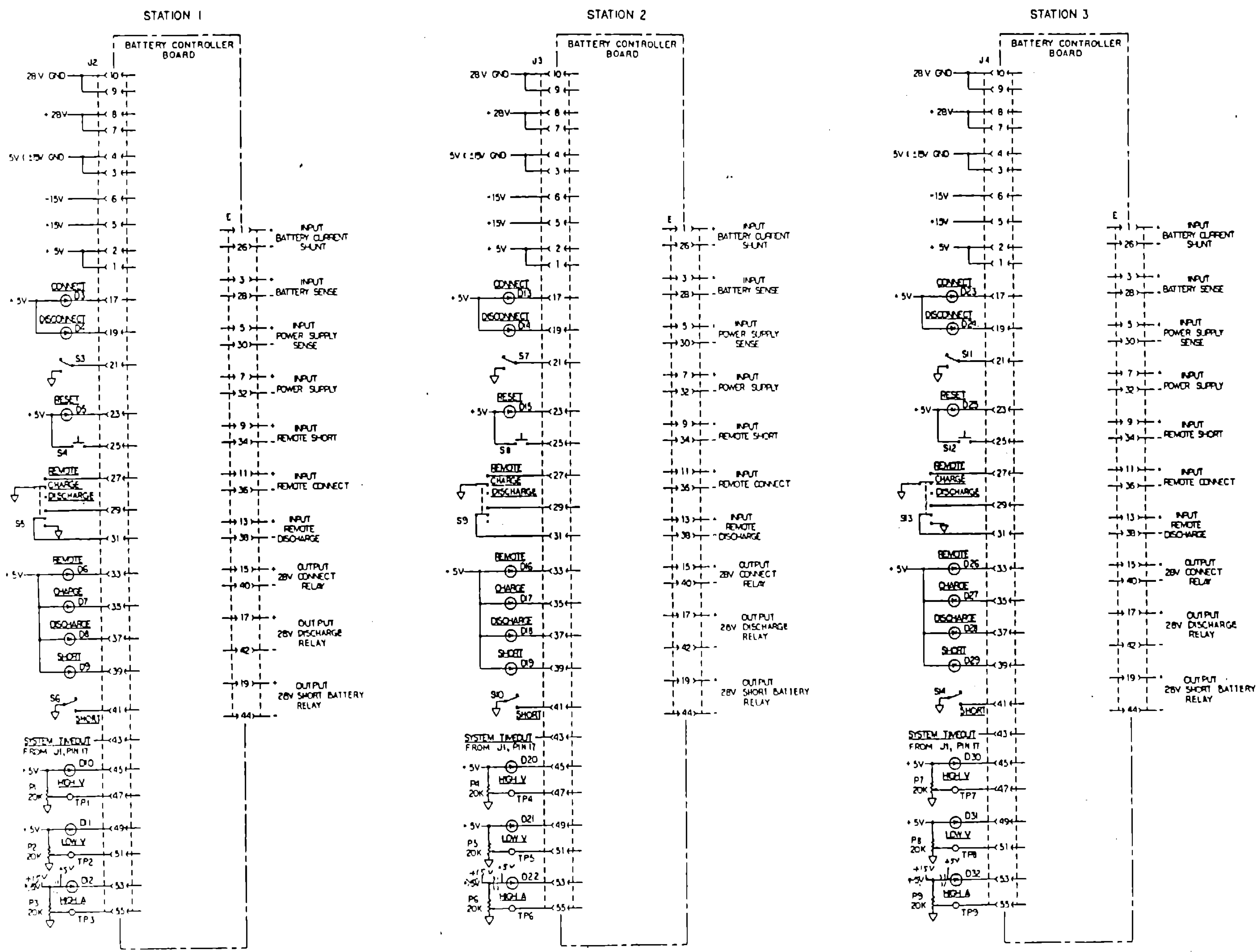
SCHEMATIC ALARM CONTROL SHEET 1 OF 2

UNCLASSIFIED

E 14213 558433



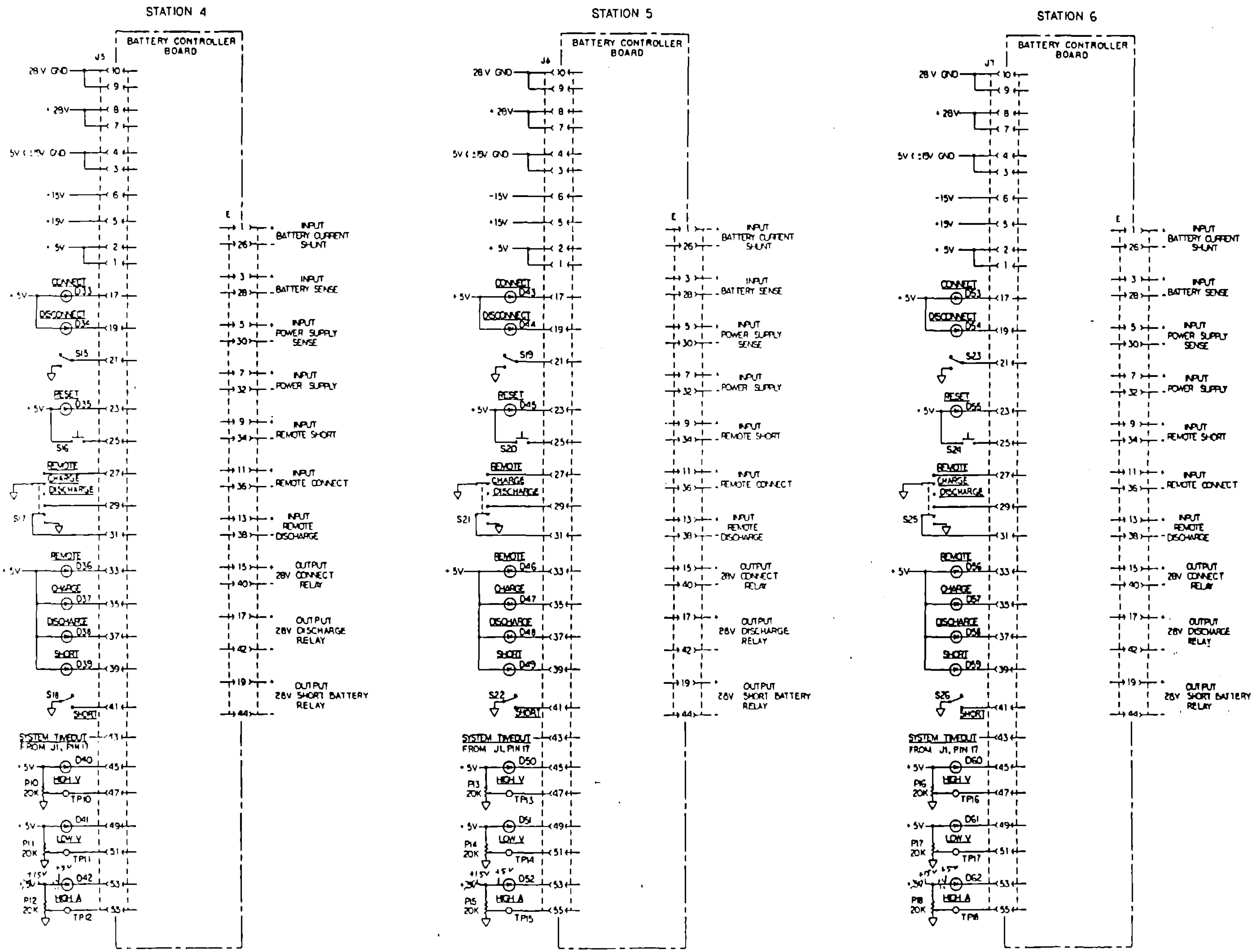
NOTES:
1. PIN NUMBERS NOT IN PARENTHESIS ARE THAT OF THE I.C.
2. PIN NUMBERS IN PARENTHESIS ARE THAT OF THE SOCKET.
HIGH A 100K
TP3
TO U20-7 (SHT 3)
TO U5-2 (SHT 3)
TO C3 1 (SHT 3)
TO U5-3 (SHT 3)
CA3290AE
TL064MJ
BATTERY CURRENT
EXTERNAL SHORT
+ POWER SUPPLY SENSE
+ POWER SUPPLY
+ BATTERY SENSE
- POWER SUPPLY SENSE
- POWER SUPPLY
- BATTERY SENSE
SYSTEM TIMEOUT FROM J1-17
U8-9 SHT 3 ZONE D6
TO R2-4,U2-1 SHT 3 ZONE G7
TO R1-1,U2-1 SHT 3 ZONE G7
SNJ5420J
SNJ5437J
MCA255
2N2222A
1N961B
DH0028CM
CONNECT
DISCONNECT
SHORT
28V CONNECT RELAY
28V DISCHARGE RELAY
CONNECT
EXTERNAL
DISCHARGE
1 ON(REMOTE)
2 OFF(CHARGE)
3 ON(DISCHARGE)
ON
OFF
ON
REMOTE
DISCHARGE
CHARGE
28V SHORT BATTERY RELAY
SCHEMATIC ALARM CONTROL SHEET 2 OF 2
UNCLASSIFIED



STATIONS 1,2,3
BATTERY CONTROLLER
BOARDS

UNCLASSIFIED

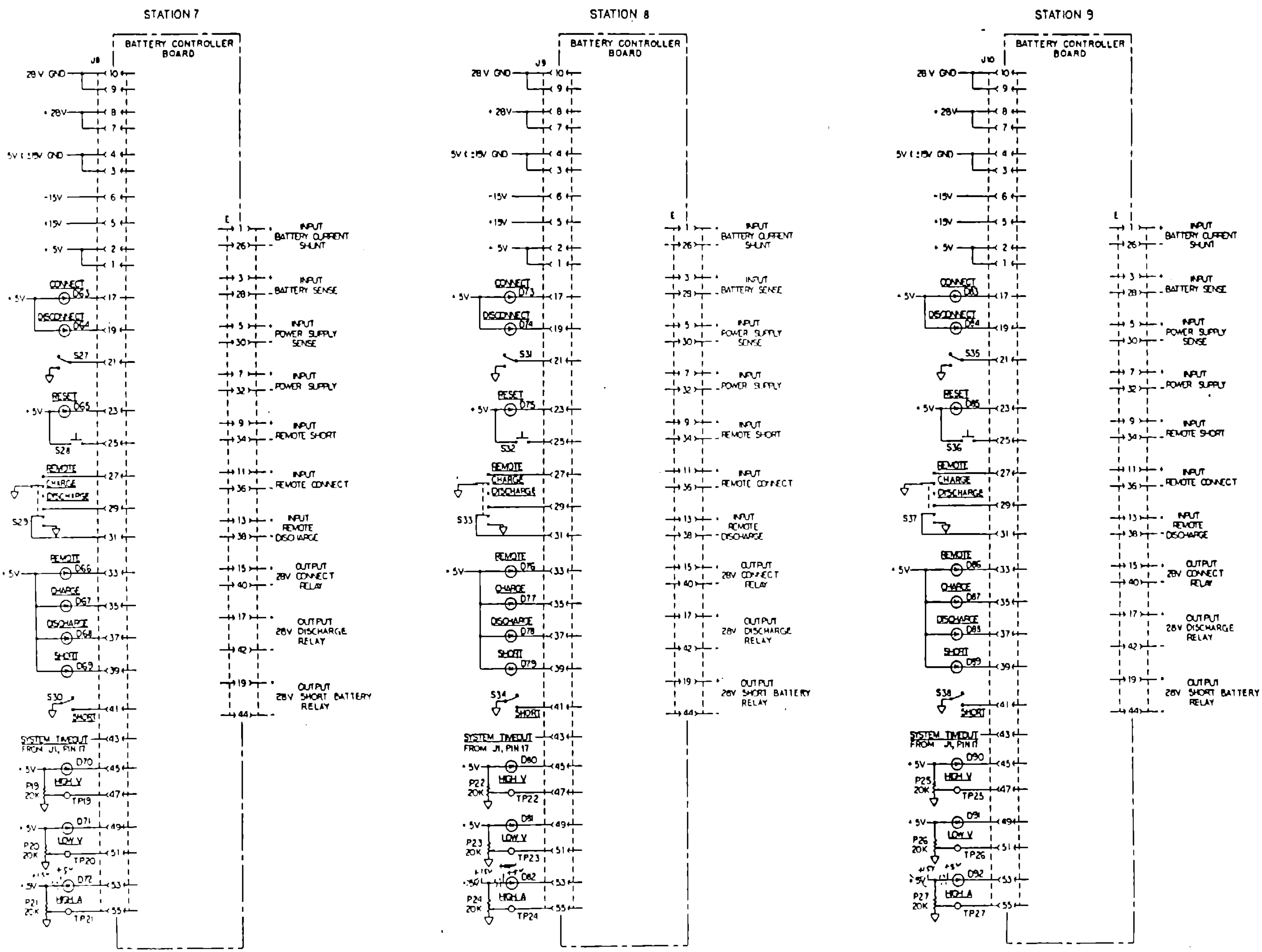
538433



STATIONS 4,5,6
BATTERY CONTROLLE
BOARDS

UNCLASSIFIED

558433



STATIONS 7,8,9
BATTERY CONTROLLER BOARDS

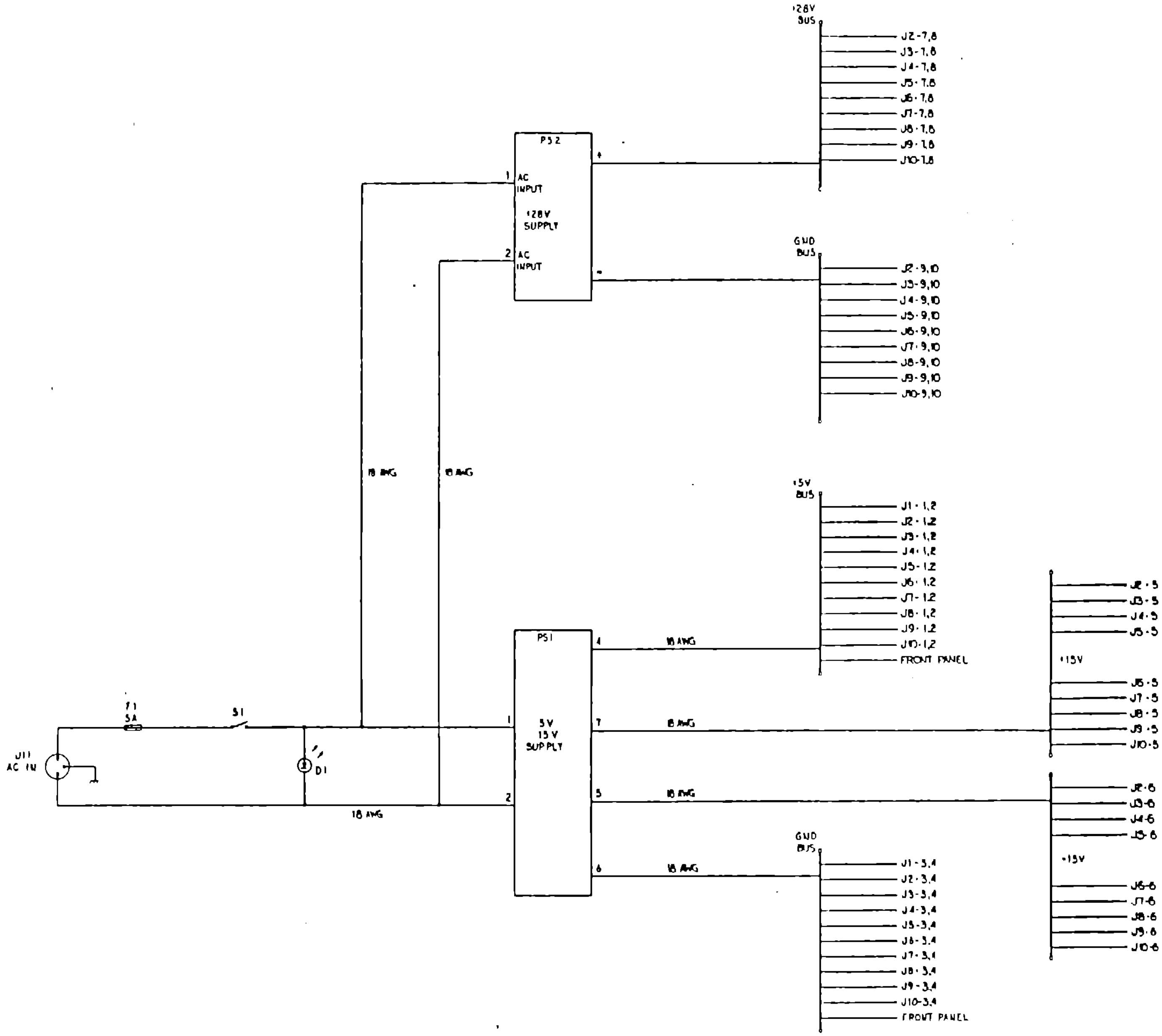
UNCLASSIFIED

E | K213 | 558433

NONE

NOTES:
1. +28V GROUND MUST NOT B[illegible]D TO +5V GROUND.

538433-000	A	R. RICHARDSON,2853 BUTLER,2545



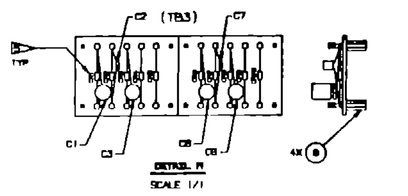
BATTERY TEST RELAY BOX

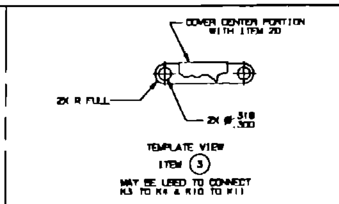
UNCLASSIFIED

UNCLASSIFIED

E 14213 538433

High Current Relay Control Chassis
Layout And Electrical Schematic





ENGRAVE .300/.280 INCH HIGH CONDENSED CHARACTERS, GROOVE WIDTH .030/.025 INCH WIDE, BLACK FILLER, LOCATE APPROXIMATELY AS SHOWN.

REFERENCE DESIGNATIONS APPEARING WITHIN A DOTTED RECTANGLE ARE TO BE MARKED ON BOTH SIDES.

UNDERLINED REFERENCE DESIGNATIONS ARE TO BE MARKED ON FAR SIDE ONLY.

DO NOT MARK DESIGNATIONS APPEARING WITHIN BRACKETS.

12. CLEAN AND APPLY ALODINE 1200 FINISH PER MIL-C-5541 TO ALL ALUMINUM SURFACES.

CLEAN AND APPLY ALODINE 1200 FINISH PER MIL-C-5541, APPLY ZINC CHROMATE PRIMER PER TT-P-1757, FOLLOWED BY MINT GRAY HP810-0331 ENAMEL.

NOTES:

1. GENERAL REQUIREMENTS PER 8000000.
2. FOR SPECIFIC PROCESSING, MANUFACTURING & ASSEMBLY REQUIREMENTS NOT OTHERWISE COVERED IN THIS DRAWING, SEE 173128.

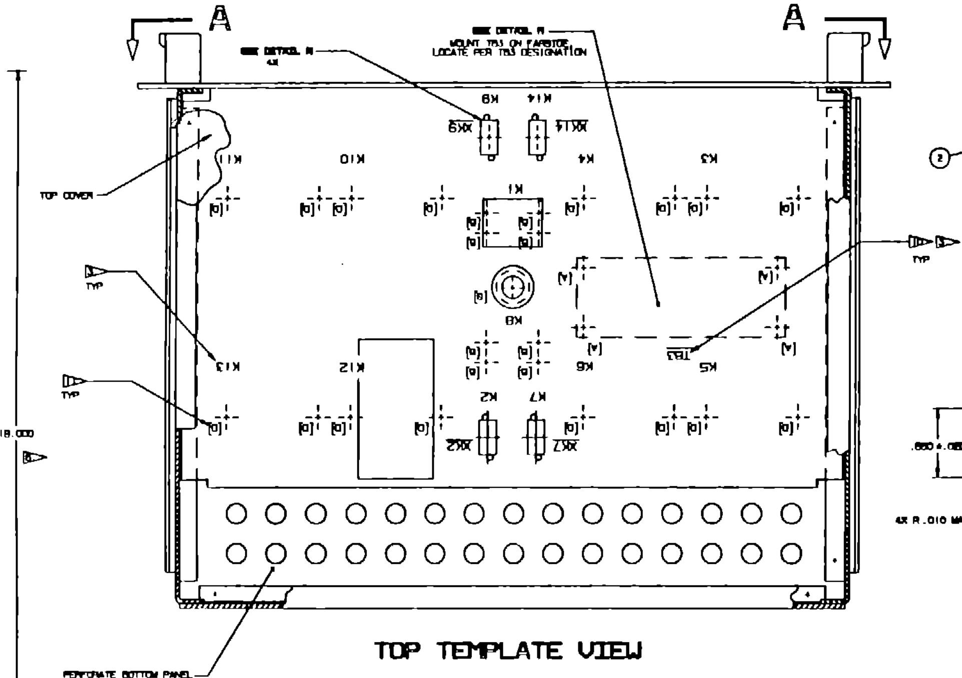
MARK IDENTIFICATION DESIGNATIONS PER 9919100 CLASS A-2, METHOD OPTIONAL, CHARACTER HEIGHT TO BE .180/.200, LOCATE APPROXIMATELY AS SHOWN.

MARK IDENTIFICATION DESIGNATIONS PER 9919100 CLASS A-2, METHOD OPTIONAL, CHARACTER HEIGHT TO BE .120/.130, LOCATE APPROXIMATELY AS SHOWN.

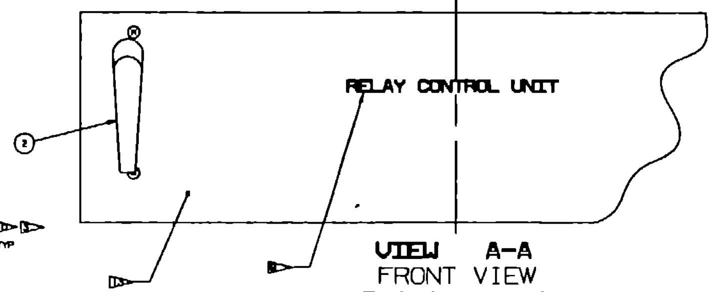
MARK IDENTIFICATION DESIGNATIONS PER 9919100 CLASS A-2, METHOD OPTIONAL, CHARACTER HEIGHT TO BE .100/.120, LOCATE APPROXIMATELY AS SHOWN.

USE THIS DIMENSION FOR PRINT INSPECTION ONLY. DO NOT USE PRINTS THAT ARE MORE THAN .100 INCH OUT OF SCALE FOR DRILLING TEMPLATES.

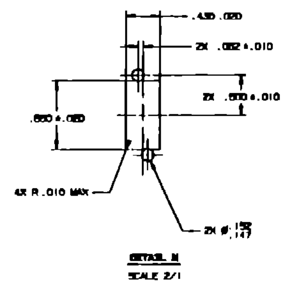
INSTALL ITEMS 10 & 11 PER MANUFACTURERS INSTRUCTIONS.

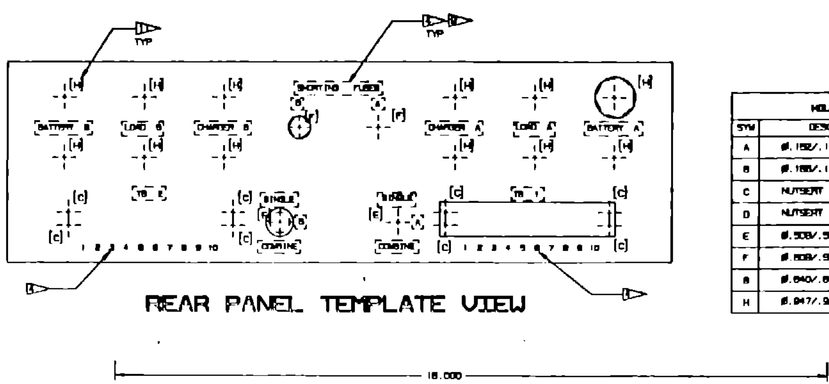


TOP TEMPLATE VIEW



VIEW A-A
FRONT VIEW
ROTATED 180°





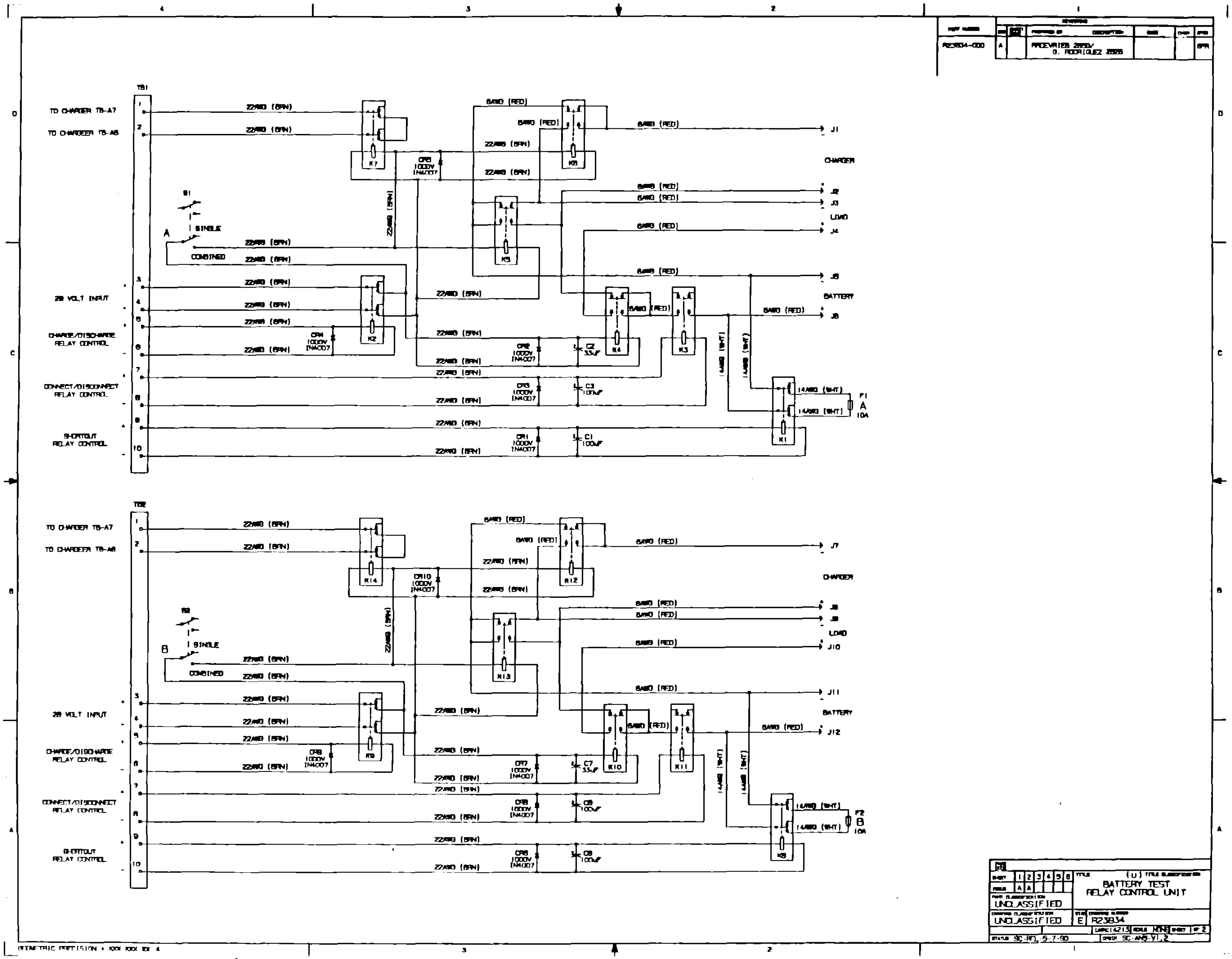
REAR PANEL TEMPLATE VIEW

HOLE TABLE			
SYM	DESCRIPTION	QTY	HDW
A	⌀.152/.147	4	4-40
B	⌀.188/.180	8	6-32
C	NUTSERT (10)	8	6-32
D	NUTSERT (11)	16	8-32
E	⌀.508/.500	2	----
F	⌀.908/.900 x .478/.468	2	----
G	⌀.840/.813	1	----
H	⌀.947/.937	12	----

QTY	PART/CONTROL NO.	DESCRIPTION/MATERIAL	MFR	NOTE	REF	ITEM
4	HRT-302W	SOCKET, RELAY, 6216	ARMEL		XK2,7,8,14	
2	342003	FUSE HOLDER			XF1,2	
1	200-1402-48-01-02	TERM, BOARD, BREAK OFF TYPE	CTC		TB3	
2	353-11-10-001	TERMINAL BOARD (10 TERMS)	TRW		TB1,2	
2	MS25306-232	SWITCH, TOGGLE, SPDT			S1,2	
8	124-314111	RELAY, COIL, 24VDC	ESSEX		K3-6 & K10-13	
4	2WSC-2717	RELAY, 20VDC, 8325L	HI-G		K2,7,9,14	
2	00SK-84	RELAY, 28.5VDC	OHMITE		K1,8	
6	HP1000B	CONN, ELEC, RECP, (BLK), 100A	SUPERIOR		J1,3,5,7,9,11	
6	HP1000R	CONN, ELEC, RECP, (RED), 100A	SUPERIOR		J2,4,6,8,10,12	
2	3AB	FUSE, 1/4 x 1-1/4	TRACOR		F1,2	
10	1N4007	DIODE, 30A, 1kV	(627936)		CR1-10	
2	M39014/2-1356	CAPACITOR, 50V, .33μF	KEMET		C2,7	
4	107M050DDA	CAPACITOR, 50V, 100μF	SPRAGUE		C1,3,6,8	
						24
AR	FAL-THHN-8-16	WIRE, AWG8, TYPE THHN, (RED)	SUMMIT			23
AR	1035-1	WIRE, AWG14, TYPE C, (WHT)	ALPHA			22
AR	8803-1	WIRE, AWG22, TYPE B, (BRN)	BELDEN			21
AR	FIT-221-3/8	INSULATION, SLEEVING, SHRINK	ALPHA			20
AR	FIT-221-1/4	INSULATION, SLEEVING, SHRINK	ALPHA			19
						18
						17
						16
48	ALT-14	LUG, TERMINAL, #8	SUMMIT			15
12	32851	LUG, TERMINAL, #22	AMP			14
4	32858	LUG, TERMINAL, #14	AMP			13
20	485-18-11-018	LUG, TERMINAL	TRW			12
16	FEX-832	NUTSERT, .164 (#8)-32UNC-2B	PEM			11
8	FEX-632	NUTSERT, .138 (#6)-32UNC-2B	PEM			10
4	2104-440-A22	SPACER, HEX, FEMALE, .250	RAF			9
1	21	GROMMET, RUBBER, .563 I.D.	R/C			8
						7
						6
						5
						4
2	QQ-C-576	BAR, BUS, COPPER, .062THK	(50082)			3
1	HO-8	HANDLE SET, DOOR	ZERO			2
1	DB6EM-5-2-3	CHASSIS, ELEC, EQPT 5.25x13	ZERO			1
NA	9919100	MARKING, GENERAL METHODS				
NA	173128	GEN. SPECS. FOR ACCEPTANCE EQUIP.				
NA	8000000	GENERAL REQUIREMENTS				

MECHANICAL
FOR
BATTERY TEST
RELAY CONTROL UNIT

DRAWING NUMBER: R238834
UNCLASSIFIED
SIZE E | CAGE 4213 | SCALE 1/1
SHEET 2 of 2
SC-REL-5-7-90


TB1
TO CHARGER TB-A7
TO CHARGER TB-A6
28 VOLT INPUT
CHARGE/DISCHARGE RELAY CONTROL
CONNECT/DISCONNECT RELAY CONTROL
SHORTOUT RELAY CONTROL
S1
SINGLE
COMBINED
A
22AWG (BRN)
6AWG (RED)
14AWG (WHT)
K1
K2
K3
K4
K5
K6
K7
CR1 1000V 1N4007
CR2 1000V 1N4007
CR3 1000V 1N4007
CR4 1000V 1N4007
CR5 1000V 1N4007
C1 100uF
C2 33uF
C3 100uF
F1 A 10A
J1
CHARGER
J2
J3
LOAD
J4
J5
BATTERY
J6
TB2
S2
B
K8
K9
K10
K11
K12
K13
K14
CR6 1000V 1N4007
CR7 1000V 1N4007
CR8 1000V 1N4007
CR9 1000V 1N4007
CR10 1000V 1N4007
C7 33uF
C8 100uF
F2 B 10A
J7
J8
J9
J10
J11
J12
R23834-000
A
RROEVRIES 28SOV
G. RODRIGUEZ 2888
BATTERY TEST
RELAY CONTROL UNIT
(U)
UNCLASSIFIED
UNCLASSIFIED
E
R23834
14213
NONE
OF 2
SC-RFL 5-7-90
SC-ANS-Y1.2

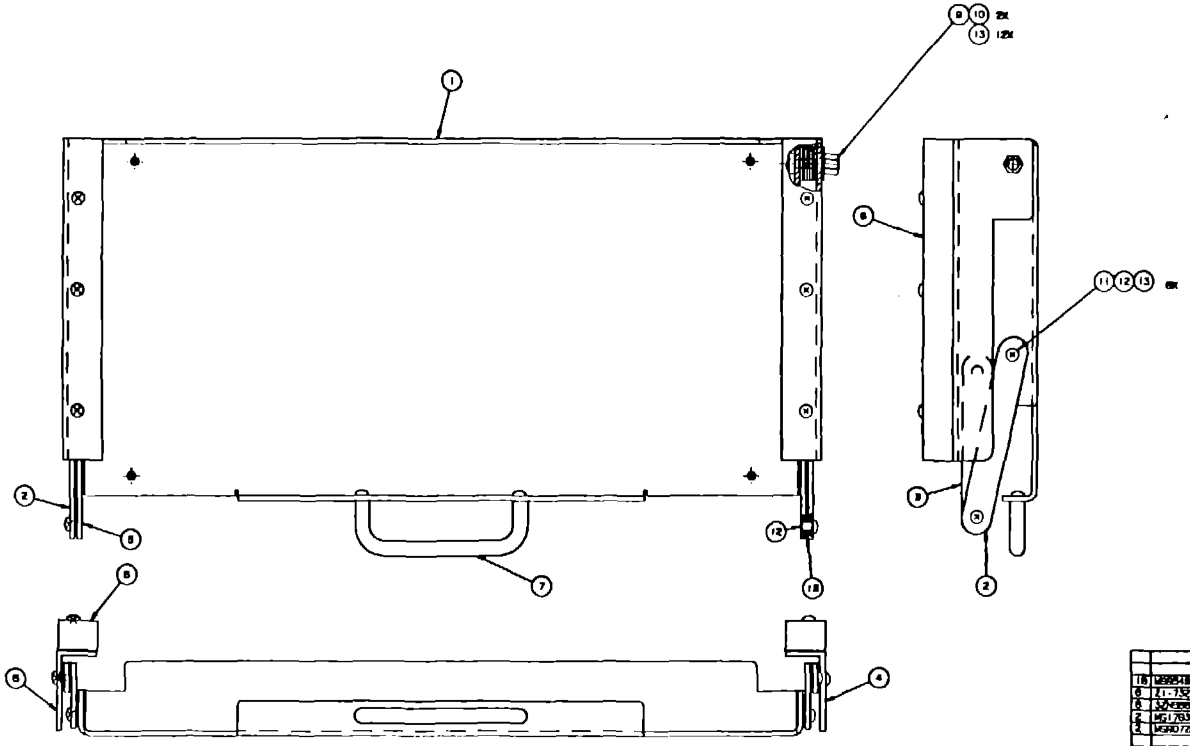
Keyboard Support Tray

NOTES:

1. FOR SPECIFIC PROCESSING MANUFACTURING AND ASSEMBLY REQUIREMENTS NOT OTHERWISE COVERED ON THIS DRAWING SEE 173128.

2. CLEAN AND APPLY ALODINE 1200S FINISH PER MIL-C-5541 AND PRIMER ZINC CHROMATE PER TT-P-1757, FOLLOWED BY ENAMEL, MINT GRAY H.P. 6010-0531.

PART NUMBER	REV		DESCRIPTION	DATE	CHKD	APPD
UA4985-000	A		G. VAITKUS 2850 \ G. RODRIGUEZ 2925			G.S.



QTY	PART / CONTROL NO.	DESCRIPTION			ITEM
					15
					14
16	MS35649	WASHER, FLAT 9/32 ID 5/8 OD CRES			13
6	21-75270-1032-10	STAND-OFF, SLF SWAGE (SPS)			12
6	32468888	SCREW, MCH, SLT RND HD, 10-32 X 1/4			11
2	MS17830-4C	NUT, SLFLOK, 1/4-20			10
2	MS90728-8	SCREW, MACHINE, HEX HD, 1/4-20X1.00			9
					8
1	UA4985-106	HANDLE			7
2	UA4985-105	SPACER			6
1	UA4985-104	ANGLE RACK MOUNTING LEFT			5
1	UA4985-103	ANGLE RACK MOUNTING RIGHT			4
2	UA4985-102	PANEL SUPPORT BAR LONG			3
2	UA4985-101	PANEL SUPPORT BAR SHORT			2
1	UA4985-100	KEYBOARD SUPPORT PANEL			1
NA	173128	GEN. SPECS. FOR ACCEPTANCE EQUIP.			

SHEET	1	2	3	4	5	6
REV	A	A				

TITLE (U) TRAY, KEYBOARD

PART CLASSIFICATION: UNCLASSIFIED

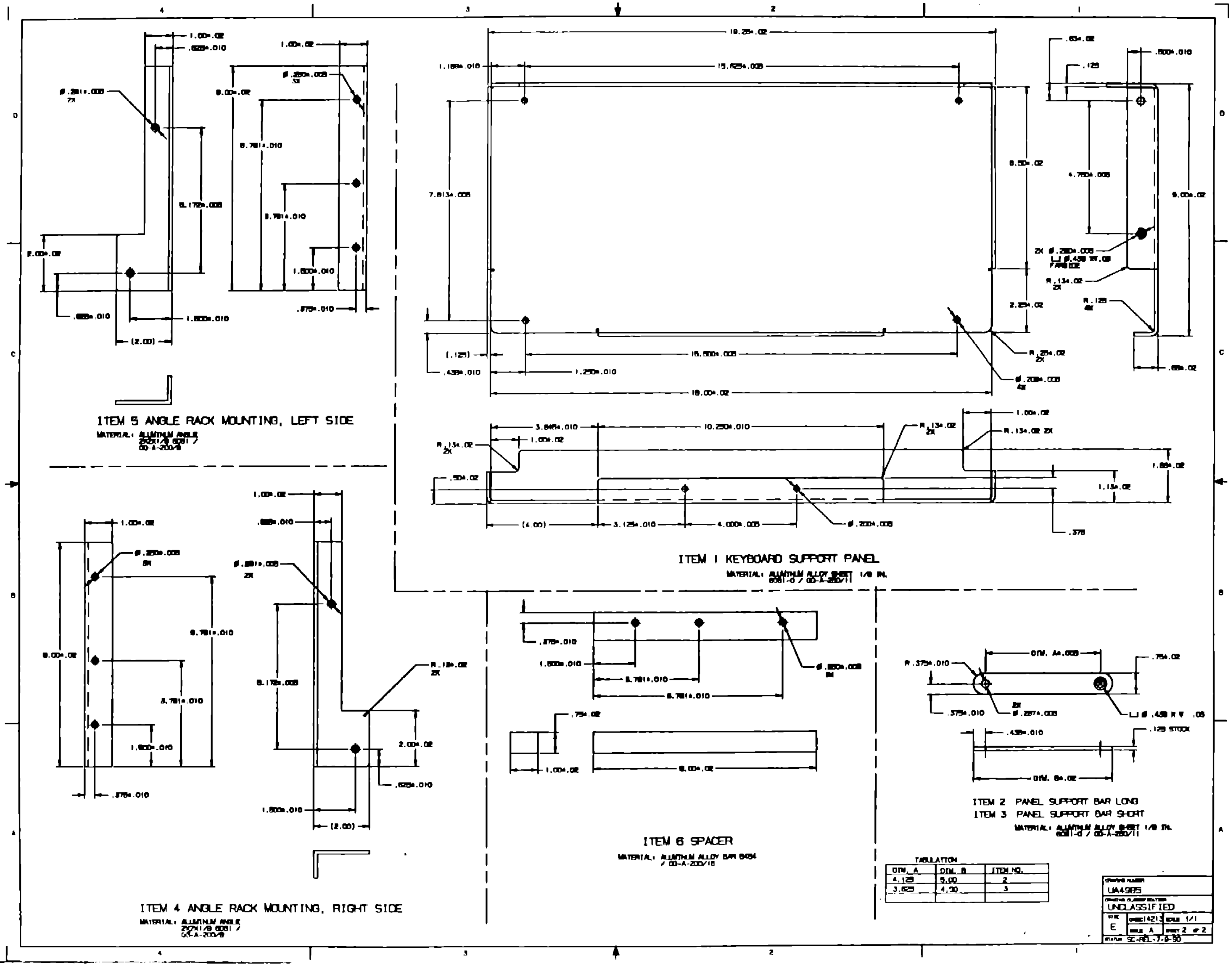
DRAWING CLASSIFICATION: UNCLASSIFIED

SIZE E DRAWING NUMBER UA4985

CAGE 14213 SCALE 1/1 SHEET 1 OF 2

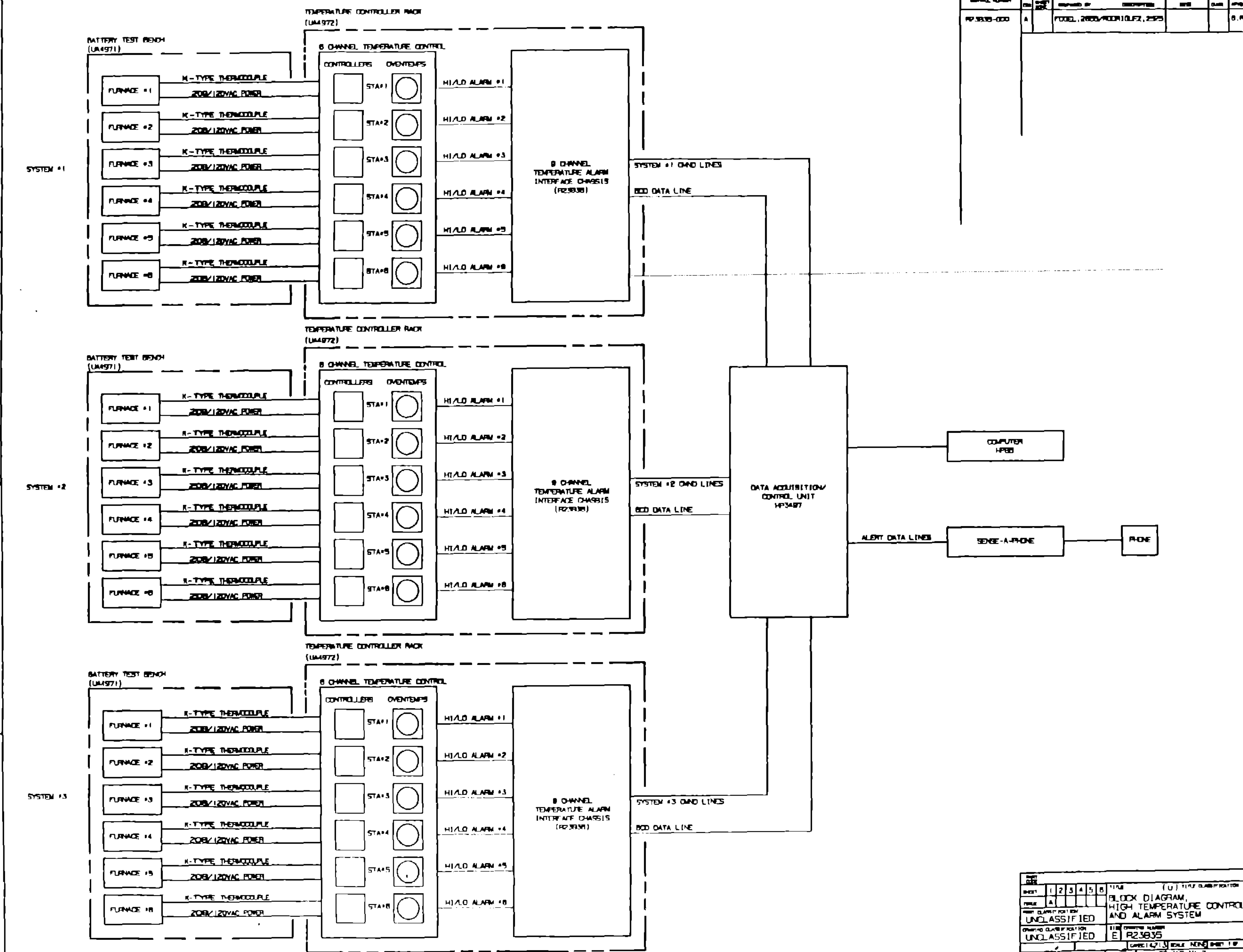
STATUS SC-REL-7-9-90 CREATE SC AND-V1.2

ISOMETRIC PROJECTION + .XXX .XXX .XX .4


ITEM 5 ANGLE RACK MOUNTING, LEFT SIDE
MATERIAL: ALUMINUM ANGLE 2X2X1/8 6061 / QQ-A-200/8
ITEM 1 KEYBOARD SUPPORT PANEL
MATERIAL: ALUMINUM ALLOY SHEET 1/8 IN. 6061-0 / QQ-A-250/11
ITEM 4 ANGLE RACK MOUNTING, RIGHT SIDE
MATERIAL: ALUMINUM ANGLE 2X2X1/8 6061 / QQ-A-200/8
ITEM 6 SPACER
MATERIAL: ALUMINUM ALLOY BAR 6464 / QQ-A-200/16
ITEM 2 PANEL SUPPORT BAR LONG
ITEM 3 PANEL SUPPORT BAR SHORT
MATERIAL: ALUMINUM ALLOY SHEET 1/8 IN. 6061-0 / QQ-A-250/11
TABULATION
DIM. A | DIM. B | ITEM NO.
4.125 | 5.00 | 2
3.625 | 4.50 | 3
DRAWING NUMBER
UA4985
UNCLASSIFIED
E
14213
SCALE 1/1
A
SHEET 2 OF 2
SC-REL-7-9-90

High Temperature Control System

Layout And Electrical Schematics



(U)

BLOCK DIAGRAM,
HIGH TEMPERATURE CONTROL
AND ALARM SYSTEM

UNCLASSIFIED

UNCLASSIFIED

E R23835

SCALE NONE SHEET 1 OF 1

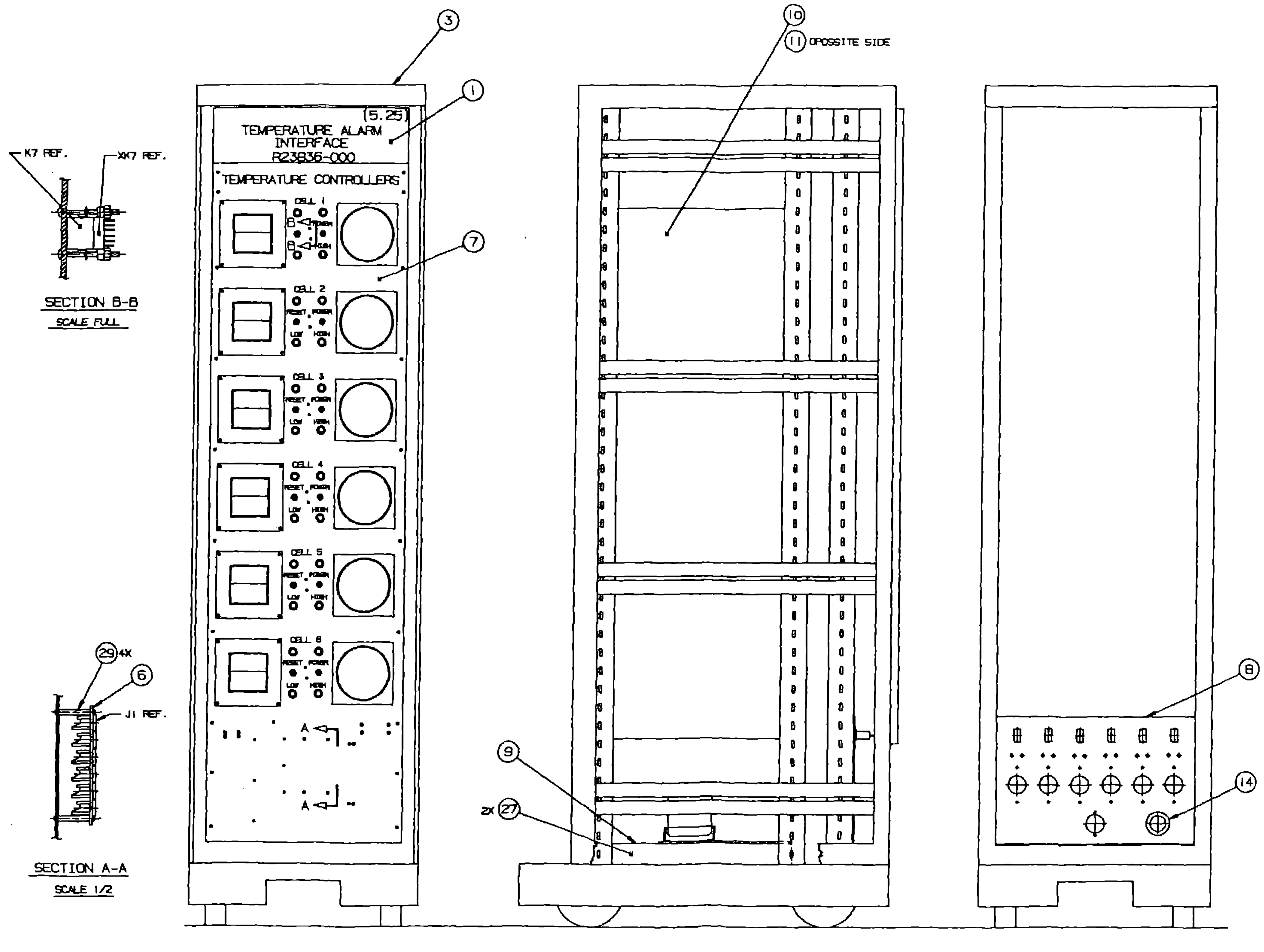
SC-TEL-9-11-90

SC-ANS-V1.2

NOTES:

1. FOR SPECIFIC PROCESSING, MANUFACTURING AND ASSEMBLY REQUIREMENTS NOT OTHERWISE COVERED ON THIS DRAWING, SEE 173126.
2. COMPONENTS NOT IDENTIFIED BY ITEM NUMBERS ON THE ASSEMBLY ARE LOCATED IN THE LIST OF MATERIAL BY REFERENCE DESIGNATIONS.

PART NUMBER	ISS	SHEET ZONE	PREPARED BY	DESCRIPTION	DATE	CHKR	AP
UA4972-000	A		D.DENNEY,2850/ G.RODRIGUEZ,2525				G.



FRONT VIEW

REAR VIEW

NO. REQD	PART/CONTROL NO.	DESCRIPTION/MATERIAL	NOTE	SHEET ZONE	ITEM
6	HRT-202	SOCKET,RELAY ARMEL			XK7-[illegible]
					XK1-
18	81-0410-0111-301	LIGHT,INDICATOR,RED DIALIGHT			XDS7-[illegible]
8	81-0410-0113-301	LIGHT,INDICATOR,AMBER DIALIGHT			XDS1-
6	105-0803-001	JACK,TIP,BLK. E.F.JOHNSON			TP2,4,6,8,10,1
6	105-0807-001	JACK,TIP,YEL. E.F.JOHNSON			TP1,3,5,7,9,1
6	CN2011K-F1	TEMPERATURE CONTROLLER OMEGA			TC1-[illegible]
2	824	TERMINAL BLOCKS,SECTIONAL,QTY 10 BUCHANAN			TB7
1		SEE ITEM 12			TB6
AR	120587	TERMINAL STRIPS PHOENIX CONTACT			TB4,[illegible]
1	2-141	BARRIER BLOCK,2 CONTACTS CINCH			TB3
1	12-141	BARRIER BLOCK,12 CONTACTS CINCH			TB2
1	2-151	BARRIER BLOCK,2 CONTACTS CINCH			TB1
6	GA5-2D40	SOLID STATE RELAY GORDOS ARKANSAS			SSR1-
6	VPAC508-208-15LER	SILICONE CONTROL RECTIFIER VECTROL			SCR1-
6	2PB12-T2	SWITCH,P.B.,DPDT,RED MICROSWITCH			S1-S[illegible]
1	LOS-R-28	POWER SUPPLY,28VDC LAMBDA			PS1
6	OST-K-M	CONN.,PLUG OMEGA			P1-P[illegible]
6	R7365C 1173 1	OVER TEMPERATURE,120V HONEYWELL			OT1-[illegible]
6	28R-1735	RELAY,ARMATURE HI-G INC			K7-1[illegible]
6	A202K2BA	RELAY,DPST,MODEL J WESTINGHOUSE			K1-K[illegible]
1	5278-C	CONN.,RECEPT.,AC HUBBELL			J19
6	L6-30	CONN.,RECEPT.,30A-250V NEMA			J13-1[illegible]
12	SPJ-K-F	CONN.,RECEPT.,PANEL OMEGA			J1-1[illegible]
24	MS25231-313	LAMP,INCANDESCENT,TYPE T-3 1/4			DS1-2[illegible]
6	AP12-020-221-0025	CIRCUIT BREAKER AIRPAX ELECT.			CB1-6
					30
4	8349	SPACER,SLEEVE,6-32,1.90 LG. H.H.SMITH			29
					28
2	286681	SUPPORT ANGLE,HORIZONTAL			27
					26
AR	TYPE THHN	WIRE,208V,6 AWG			25
AR		WIRE,THERMOCOUPLE,K TYPE,RED & YEL			24
AR	9802	WIRE,SHIELDED,TWIS.PR.,4-COND.,24 AWG BELDEN			23
AR	MIL-W-16878	WIRE,ELECT.,TYPE E,AWG 14			22
AR	MIL-W-16878	WIRE,ELECT.,TYPE E,AWG 18			21
AR	MIL-W-16878	WIRE,ELECT.,TYPE E,AWG 20			20
					19
					18
AR	MIL-P-8585	PRIMER,ZINC CHROMATE			17
AR	6010-0331	PAINT,MINT GREY H.P.			16
1	G20GB306	CONNECTOR STRIP,ELECT. WIREMOLD			15
1	RE6527	CLAMP,CABLE ROMAX			14
1	MAP-1219	PANEL,BLANK,12.25 HT. PREMIER			13
					12
1	UA4972-105	PANEL,LEFT SIDE		10	11
1	UA4972-104	PANEL,RIGHT SIDE		9	10
1	UA4972-103	PANEL,BOTTOM,POWER SUPPLY		8	9
1	UA4972-102	PANEL,REAR		5	8
1	UA4972-101	PANEL,FRONT		6,7	7
1	UA4972-100	TERMINAL BOARD,TB8		5	6
AR	QQ-A-250/11	SHEET,ALUM.,6061-T6,.125 THK			5
					4
1	105202-70	CABINET,ELECT.,EQUIP. ELECTRORACK			3
					2
1	R23836-000	TEMPERATURE ALARM INTERFACE			1
NA	173126	GEN.SPECS.FOR ACCEPTANCE EQUIP.			

SHEET	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
ISSUE	A	A	A	A																	

SHEET	1	2	3	4	5	6
ISSUE	A	A	A	A	A	A

TITLE (U) TITLE CLASSIFICATION

TEMPERATURE CONTROLLER RACK

PART CLASSIFICATION: UNCLASSIFIED

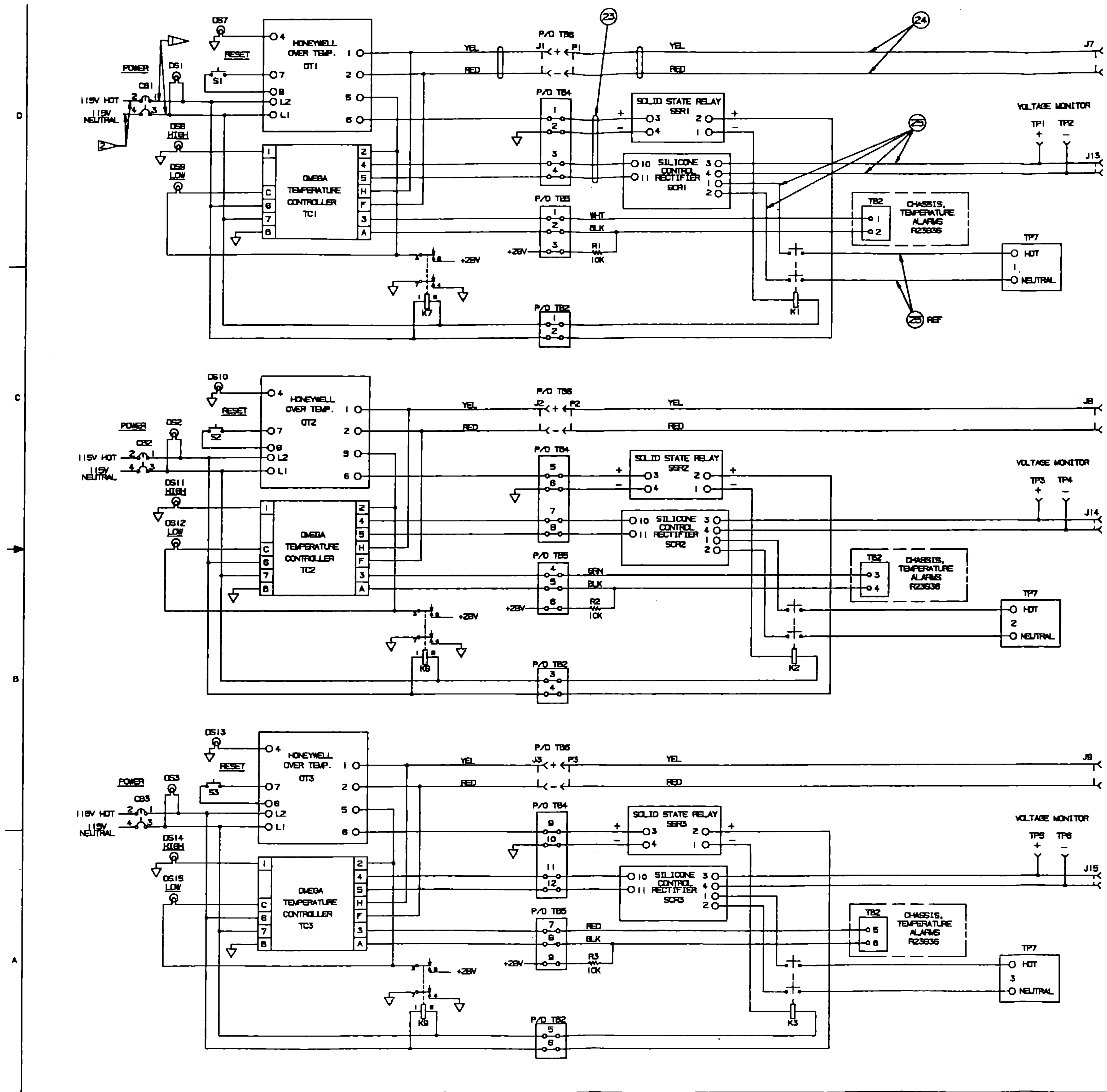
DRAWING CLASSIFICATION: UNCLASSIFIED

SIZE: E DRAWING NUMBER: UA4972

CAGE: 14213 SCALE: NONE SHEET 1 OF 1

STATUS: SC-REL-5-17-90 ORIGIN: SC-AN5-V1.2

GEOMETRIC PRECISION = XXX.XXX XX 4

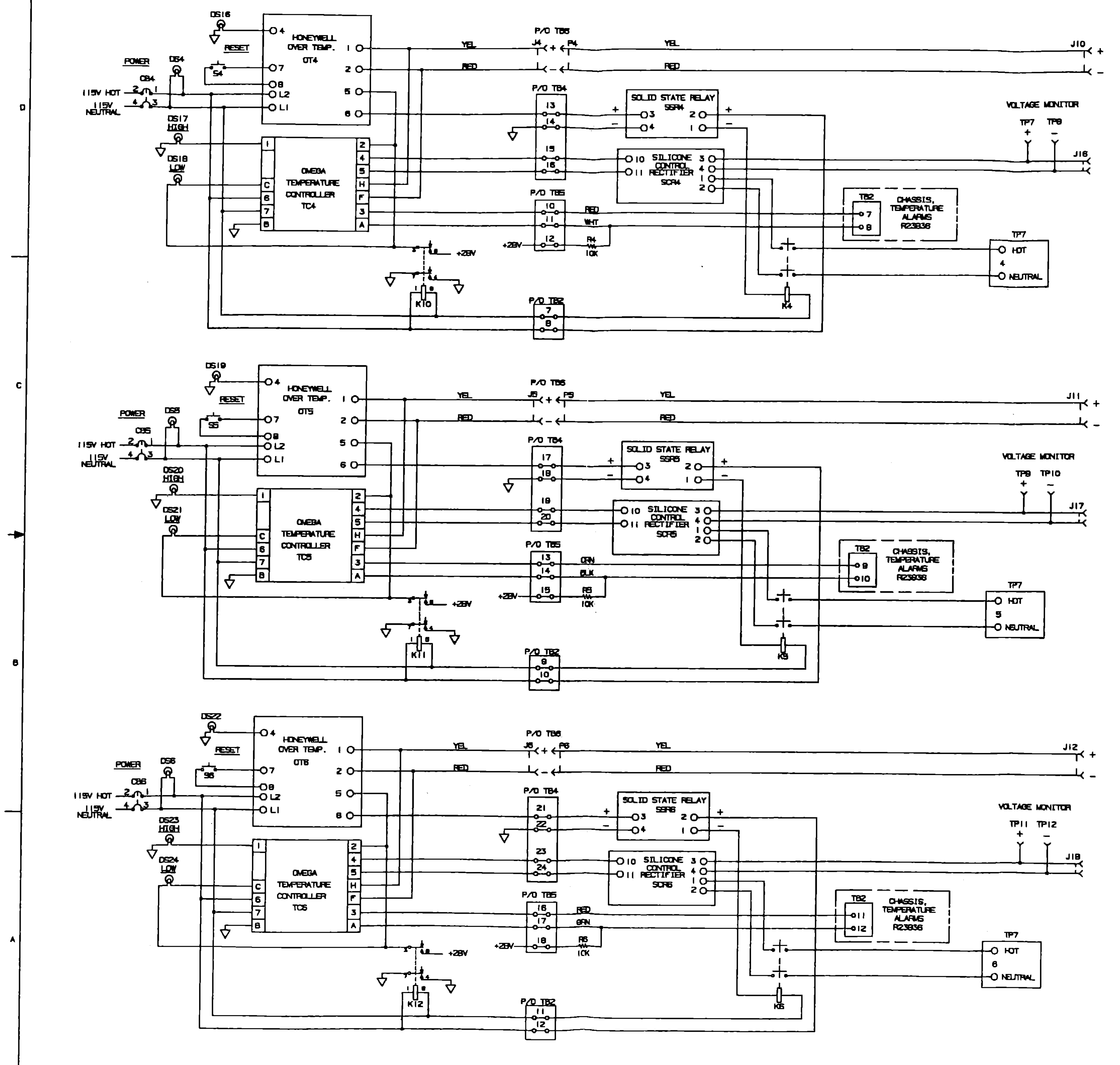


NOTES:

1. ALL WIRE PERTAINING TO 115VAC ON CIRCUIT BREAKER SIDE, PINS 1 AND 3, ITEM 21.
2. ALL WIRE PERTAINING TO 115VAC ON CIRCUIT BREAKER SIDE, PINS 2 AND 4, ITEM 22.
3. ALL WIRE PERTAINING TO 28VDC, ITEM 20, EXCEPT WHERE NOTED.

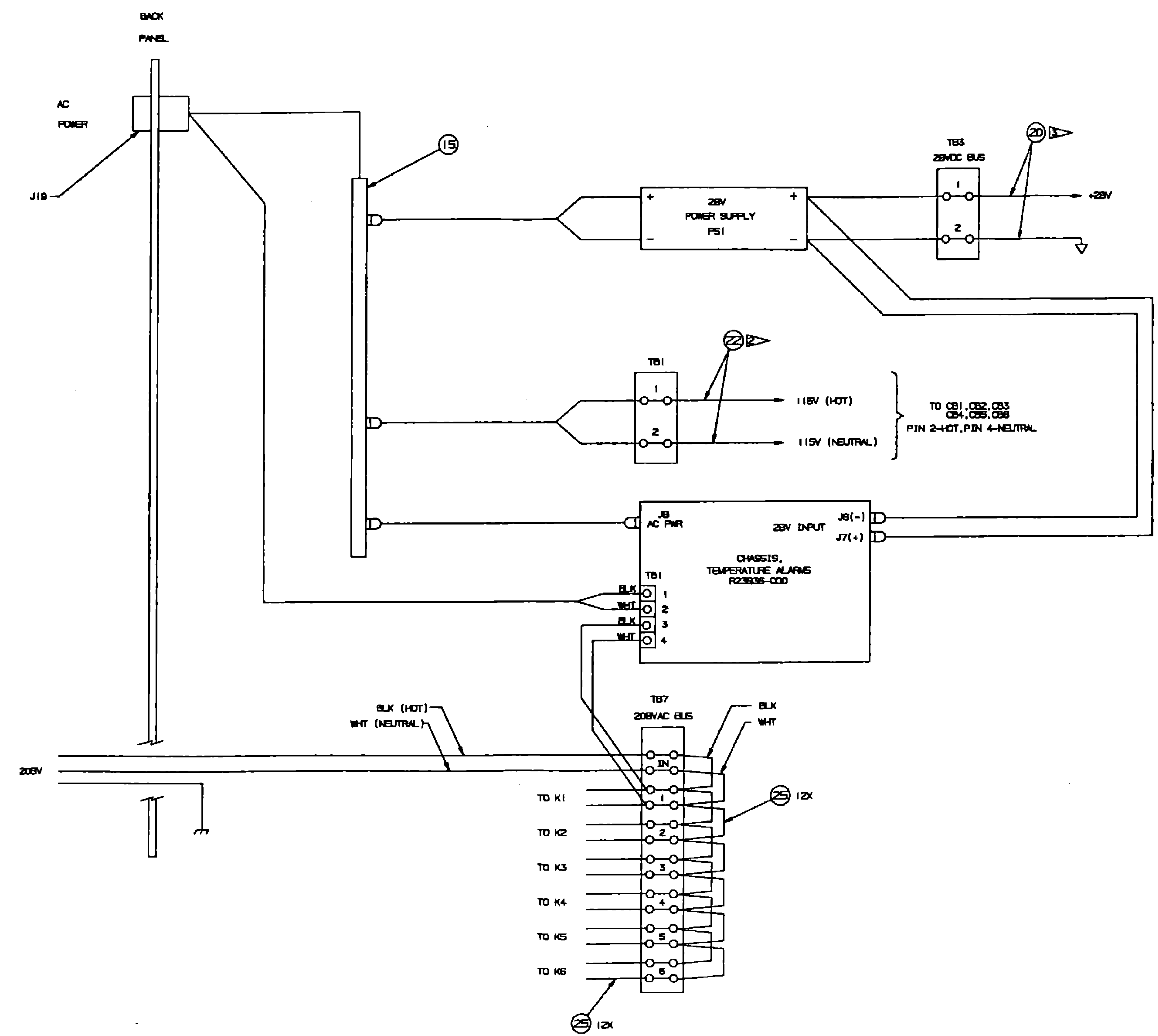
SCHEMATIC
RACK
SHEET 1 OF 3

DRAWING NUMBER	UA4972
DRAWING CLASSIFICATION	UNCLASSIFIED
SIZE	E
CAGEC	14213
SCALE	N
ISSUE	A
SHEET	2
STATUS	SC-REL-5-17-90



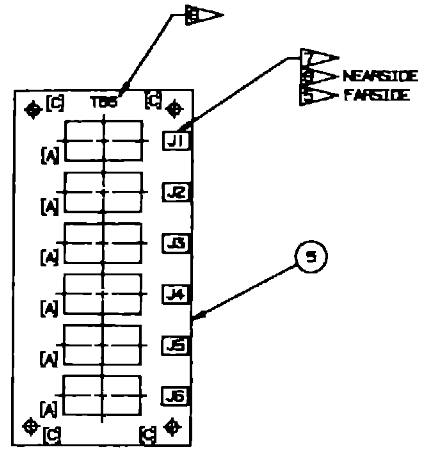
SCHEMATIC
RACK
SHEET 2 OF 3

DRAWING NUMBER	UA4972
DRAWING CLASSIFICATION	UNCLASSIFIED
SIZE E	CAGEC 14213 · SCALE NONE
ISSUE A	SHEET 3 OF
STATUS	SC-REL-5-17-90

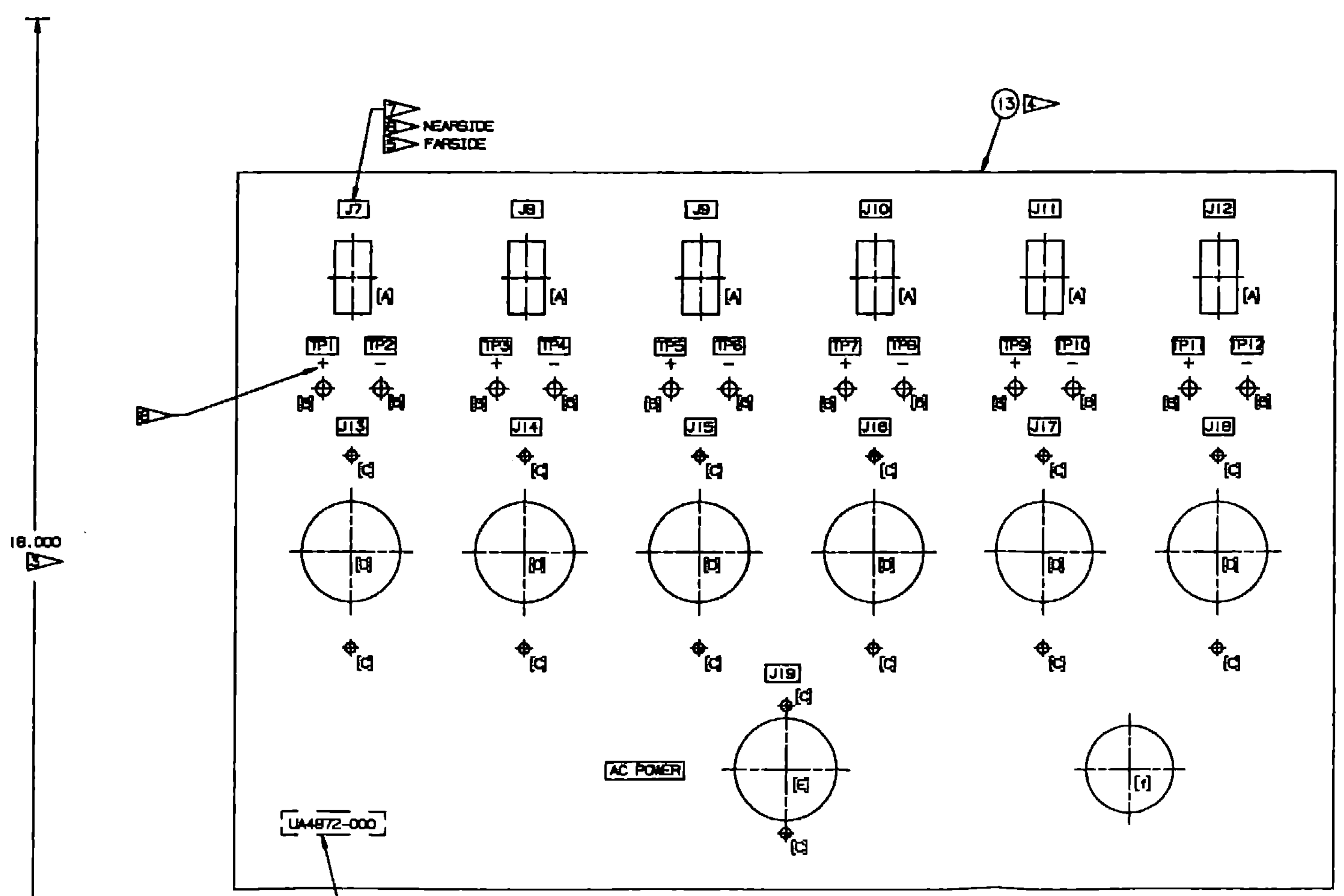


SCHEMATIC
RACK
SHEET 3 OF 3

DRAWING NUMBER	UA4972
DRAWING CLASSIFICATION	UNCLASSIFIED
SIZE E	CAGEC 14213 · SCALE NONE
	ISSUE A · SHEET 4 OF 1
STATUS	SC-REL-5-17-90



ITEM 6, TB6-TERMINAL BOARD, TEMPLATE VIEW



ITEM 8, REAR PANEL, TEMPLATE VIEW

18.000

NOTES:

1. FOR SPECIFIC PROCESSING, MANUFACTURING AND ASSEMBLY REQUIREMENTS NOT OTHERWISE COVERED ON THIS DRAWING, SEE 173126.

2. COMPONENTS NOT IDENTIFIED BY ITEM NUMBERS ON THE ASSEMBLY ARE LOCATED IN THE LIST OF MATERIAL BY REFERENCE DESIGNATIONS.

3. USE THIS DIMENSION FOR PRINT INSPECTION MEASUREMENT ONLY. DO NOT USE PRINTS MORE THAN .100 INCH OUT OF SCALE FOR DRILLING TEMPLATES.

4. CLEAN AND APPLY ALODINE 1200 FINISH PER MIL-C-5541 AND PRIMER ZINC CHROMATE PER TT-P-1757. FOLLOWED BY ENAMEL, MINT GRAY H.P. 8010-0331.

5. MARK (WITH COVER COAT) REFERENCE DESIGNATIONS .120-INCH BLACK CHARACTERS. LOCATE APPROXIMATELY WHERE SHOWN.

6. REFERENCE DESIGNATIONS APPEARING WITHIN A DOTTED RECTANGLE ARE TO BE MARKED ON OPPOSITE SIDE.

7. REFERENCE DESIGNATIONS APPEARING WITHIN A SOLID RECTANGLE ARE TO BE MARKED ON BOTH SIDES.

8. ENGRAVE .170/.150 INCH HIGH CONDENSED CHARACTERS. GROOVE WIDTH .025/.020-INCH WIDE, BLACK FILLER. LOCATE APPROXIMATELY AS SHOWN.

HOLE TABLE

	DESCRIPTION	QTY	HDW
A	CUTOUT 1.25 X .625	12	
B	Ø.257/.250	12	
C	Ø.188/.180	18	6-32
D	Ø1.710/1.690	6	
E	Ø1.770/1.730	1	
F	Ø1.512/1.500	1	

CAD PREPARED TEMPLATE INFORMATION.
CHANGES TO THIS DWG MUST BE MADE BY CAD METHODS TO RETAIN 1/1 SCALE.

ITEM 6, TERMINAL BOARD, TB6
ITEM 8, REAR PANEL
SHEET 1 OF 1

DRAWING NUMBER UA4972		
DRAWING CLASSIFICATION UNCLASSIFIED		
SIZE E	CAGE 14213	SCALE FULL
	ISSUE A	SHEET 5 OF 1
STATUS SC-REL-5-17-90		

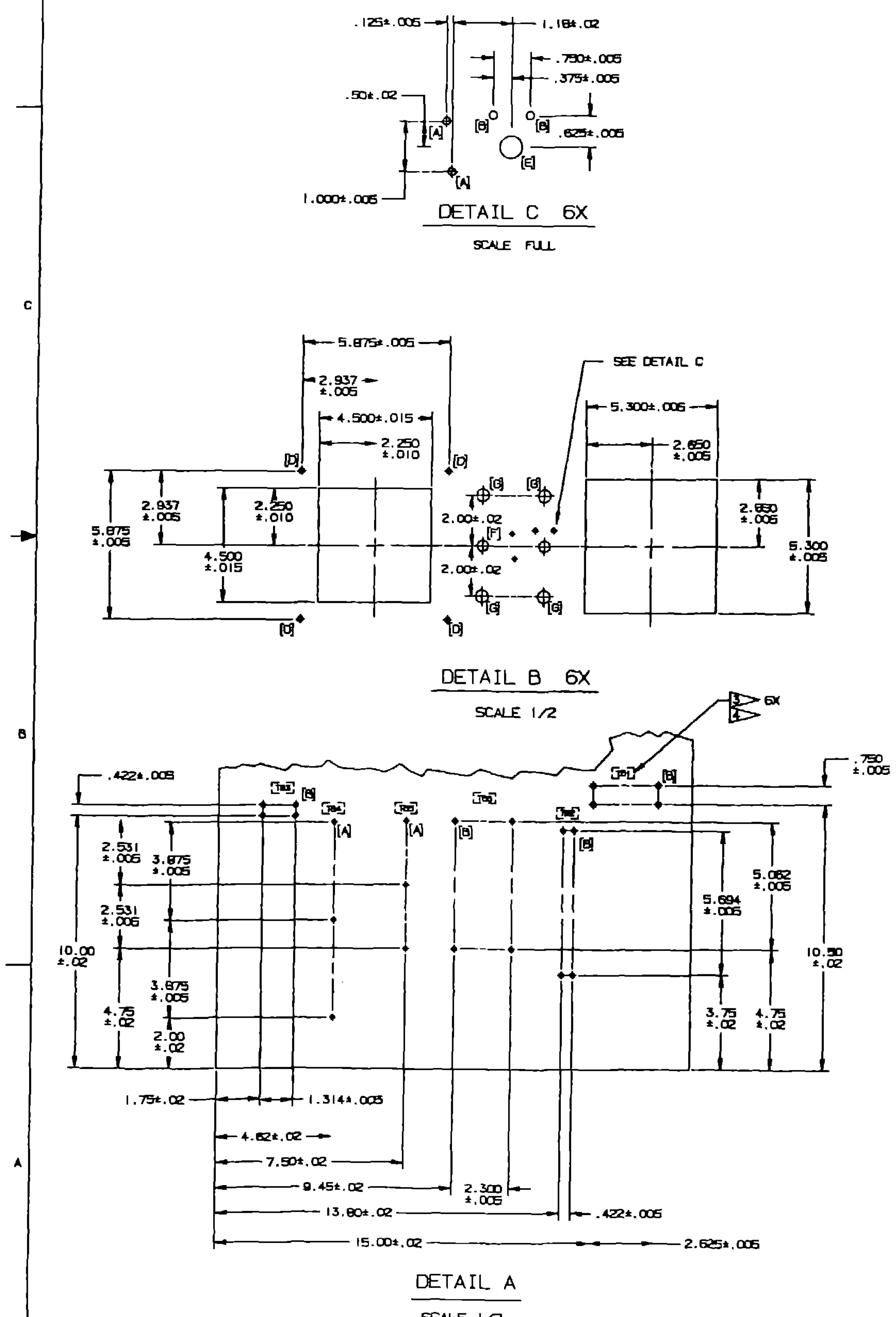
NOTES:

1. FOR SPECIFIC PROCESSING, MANUFACTURING AND ASSEMBLY REQUIREMENTS NOT OTHERWISE COVERED ON THIS DRAWING. SEE 173126.

2. CLEAN AND APPLY ALODINE 1200 FINISH PER MIL-C-5541 AND PRIMER ZINC CHROMATE PER TT-P-1757.FOLLOWED BY ENAMEL, MINT GRAY H.P. 6010-0331.

3. MARK (WITH COVER COAT)REFERENCE DESIGNATIONS .187-INCH BLACK CHARACTERS.LOCATE APPROXIMATELY WHERE SHOWN.

4. REFERENCE DESIGNATIONS APPEARING WITHIN A DOTTED RECTANGLE ARE TO BE MARKED ON OPPOSITE SIDE.



DETAIL C 6X

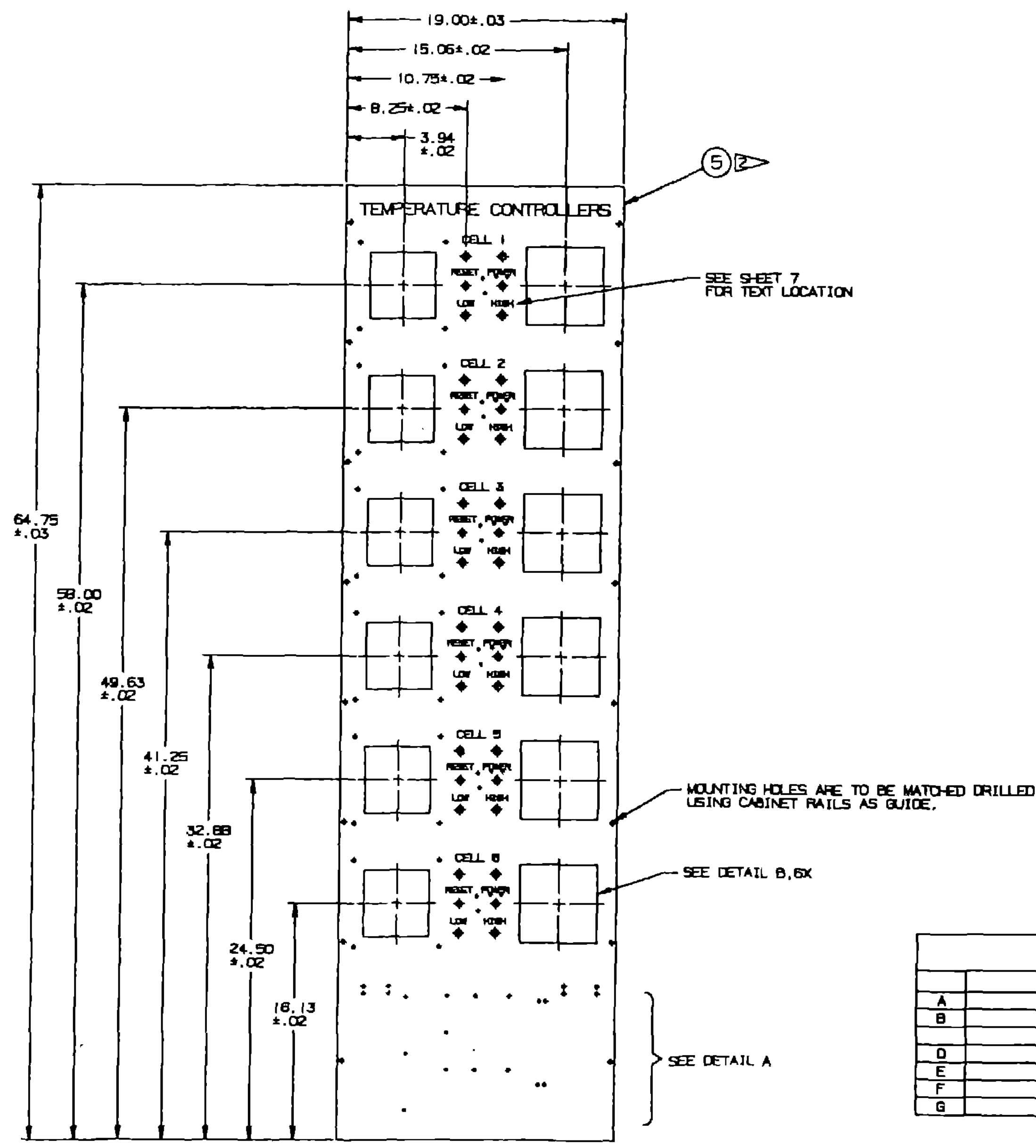
SCALE FULL

DETAIL B 6X

SCALE 1/2

DETAIL A

SCALE 1/2



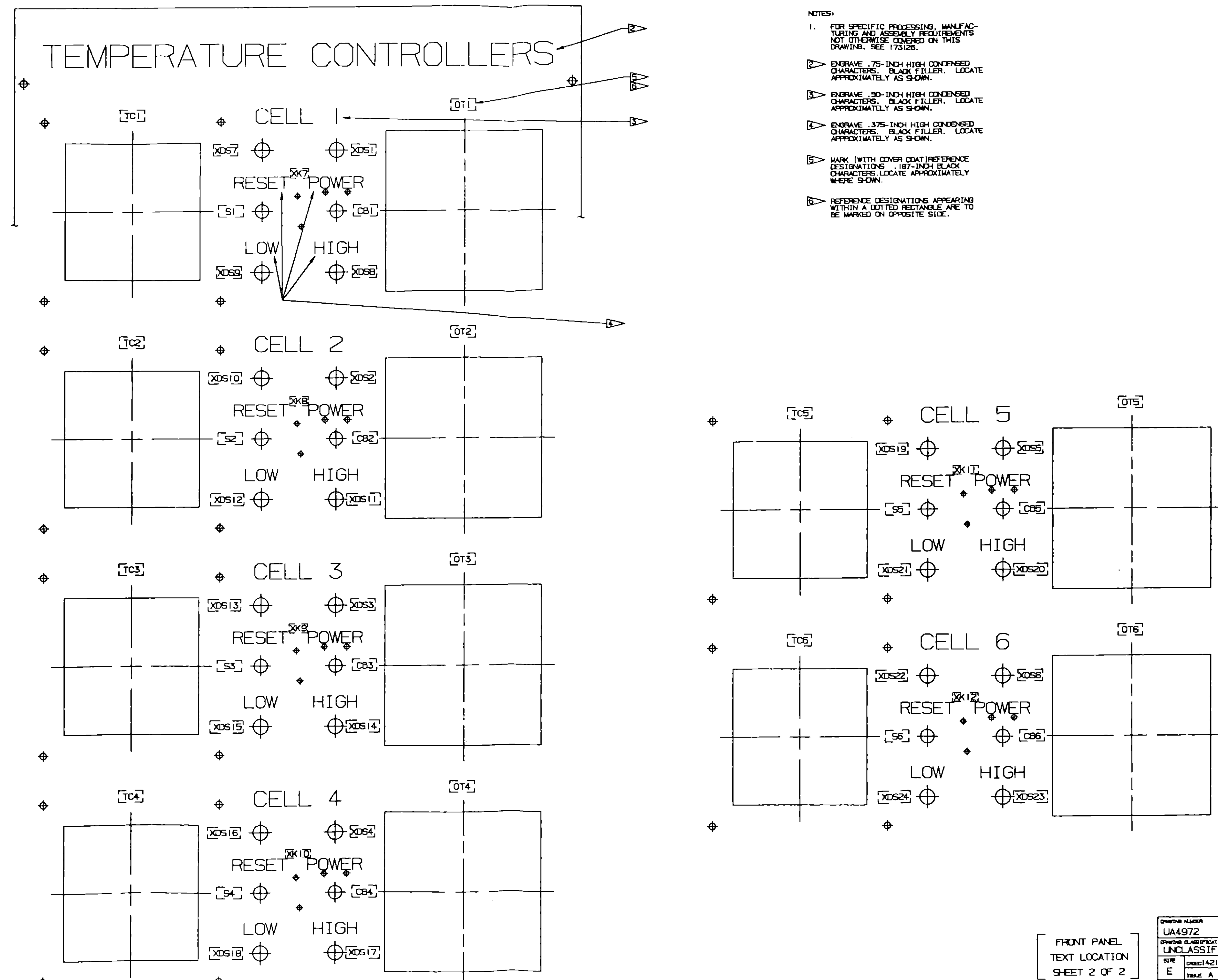
ITEM 7,FRONT PANEL

SCALE 1/4

HOLE TABLE			
	DESCRIPTION	QTY	HOW
A	Ø.152/.147	18	4-40
B	Ø.186/.180	28	6-32
D	Ø.241.234	24	10-24
E	Ø.399/.391	6	
F	Ø.508/.500	6	
G	Ø.712/.703	24	

ITEM 7
FRONT PANEL
SHEET 1 OF 2

DRAWING NUMBER	UA4972
DRAWING CLASSIFICATION	UNCLASSIFIED
SIZE	E
CAGEC	14213
SCALE	1/4
ISSUE	A
SHEET	6 OF 10
STATUS	SC-REL-5-17-90



NOTES:

1. FOR SPECIFIC PROCESSING, MANUFACTURING AND ASSEMBLY REQUIREMENTS NOT OTHERWISE COVERED ON THIS DRAWING. SEE 173126.

2. ENGRAVE .75-INCH HIGH CONDENSED CHARACTERS. BLACK FILLER. LOCATE APPROXIMATELY AS SHOWN.

3. ENGRAVE .50-INCH HIGH CONDENSED CHARACTERS. BLACK FILLER. LOCATE APPROXIMATELY AS SHOWN.

4. ENGRAVE .375-INCH HIGH CONDENSED CHARACTERS. BLACK FILLER. LOCATE APPROXIMATELY AS SHOWN.

5. MARK (WITH COVER COAT) REFERENCE DESIGNATIONS .187-INCH BLACK CHARACTERS. LOCATE APPROXIMATELY WHERE SHOWN.

6. REFERENCE DESIGNATIONS APPEARING WITHIN A DOTTED RECTANGLE ARE TO BE MARKED ON OPPOSITE SIDE.

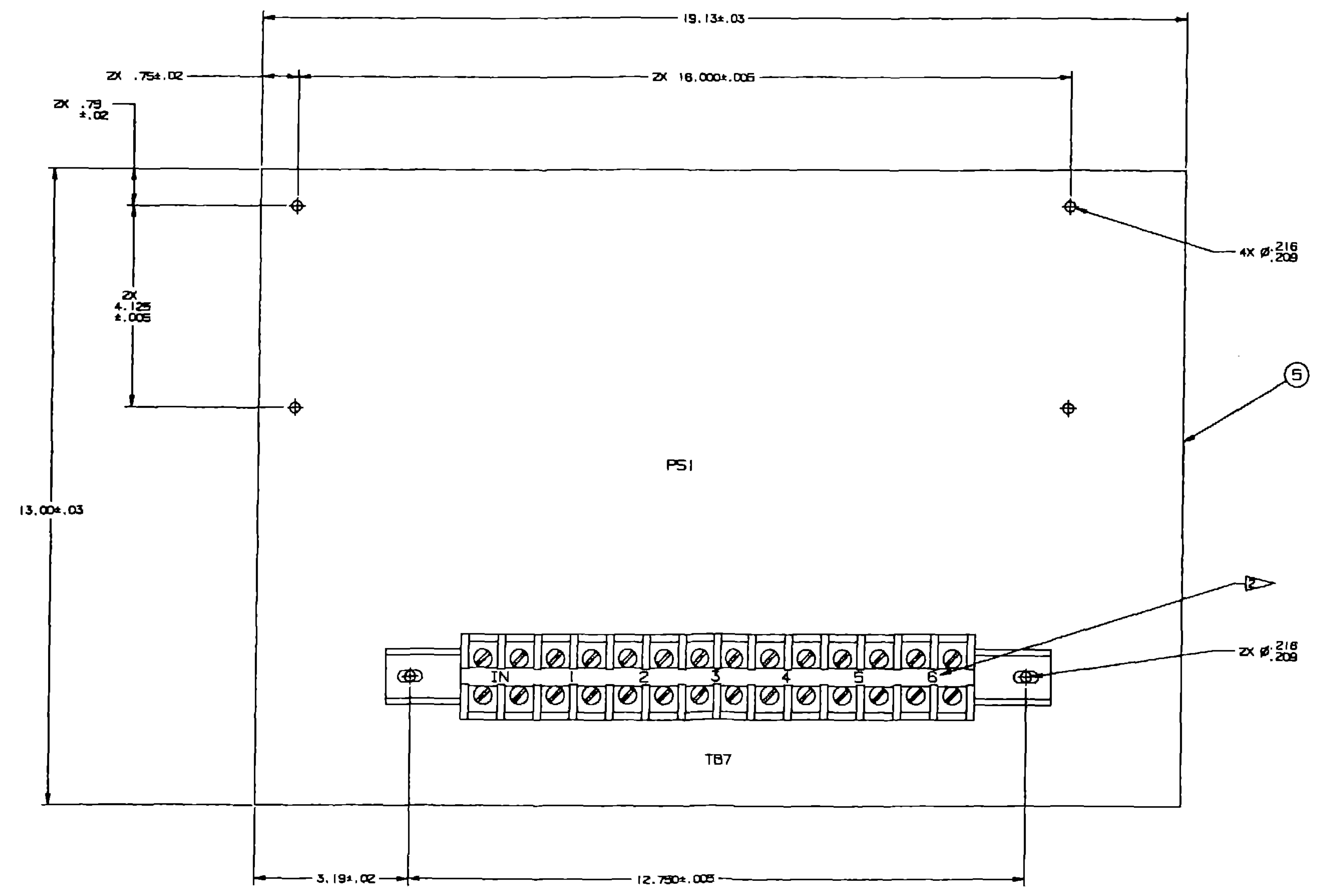
FRONT PANEL
TEXT LOCATION
SHEET 2 OF 2

DRAWING NUMBER UA4972		
DRAWING CLASSIFICATION UNCLASSIFIED		
SIZE E	CAGEC 14213	SCALE FUL
	ISSUE A	SHEET 7 OF
STATUS SC-REL-5-17-90		

NOTES:

1. FOR SPECIFIC PROCESSING, MANUFACTURING AND ASSEMBLY REQUIREMENTS NOT OTHERWISE COVERED ON THIS DRAWING. SEE 173128.

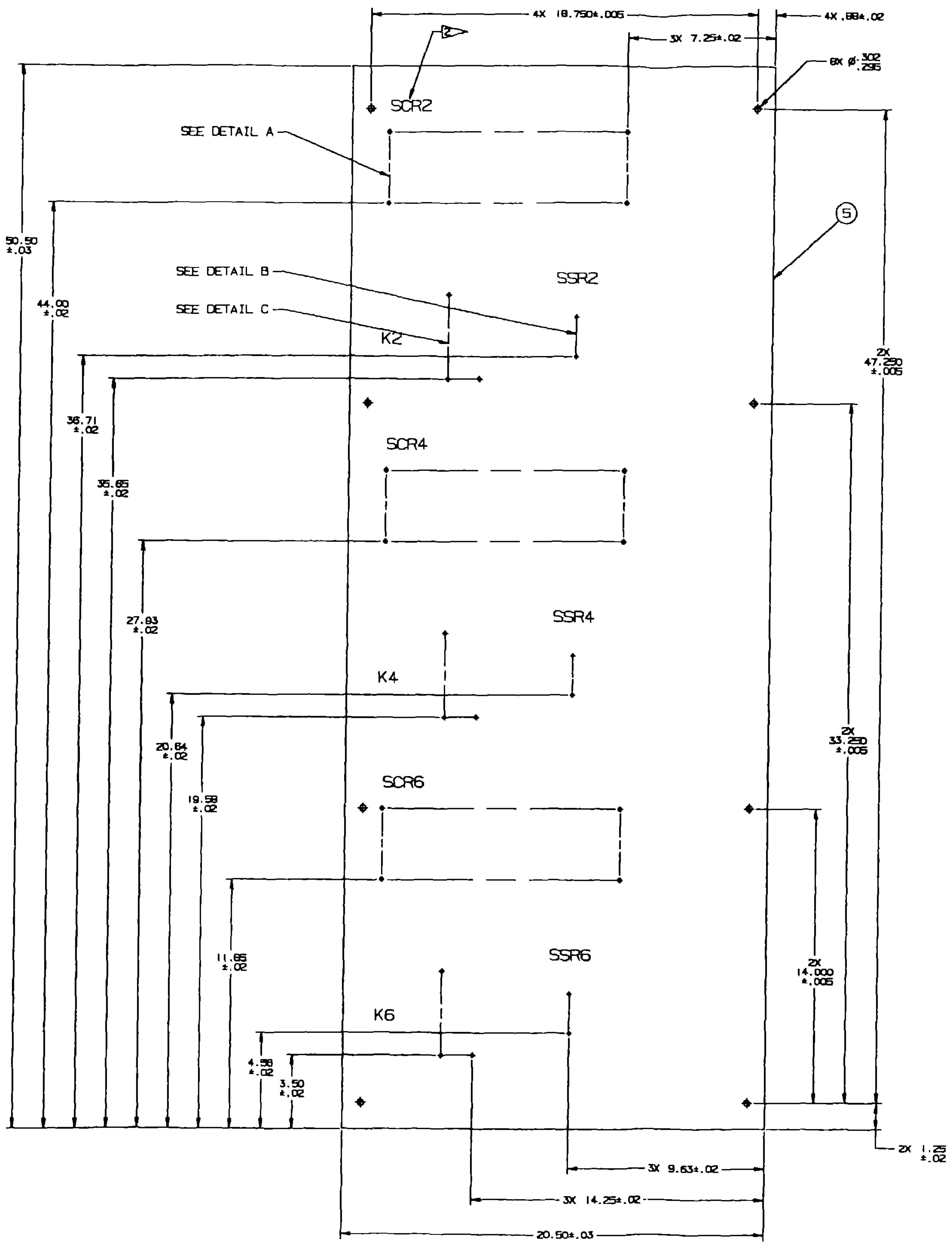
2. MARK (WITH COVER COAT) REFERENCE DESIGNATIONS .200-INCH BLACK CHARACTERS. LOCATE APPROXIMATELY WHERE SHOWN.



ITEM 9, BOTTOM PANEL, POWER SUPPLY

ITEM 9
BOTTOM PANEL
SHEET 1 OF 1

DRAWING NUMBER UA4972			
DRAWING CLASSIFICATION UNCLASSIFIED			
SIZE E	CAGE 14213	SCALE FULL	
	ISSUE A	SHEET 8 OF	
STATUS SC-REL-5-17-90			

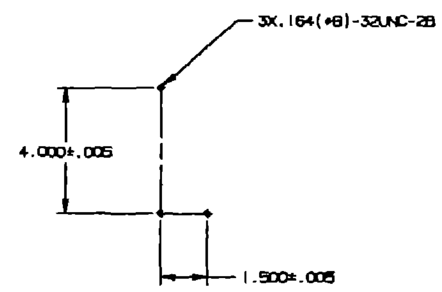


ITEM 10,RIGHT SIDE PANEL

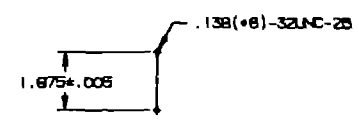
NOTES:

1. FOR SPECIFIC PROCESSING, MANUFACTURING AND ASSEMBLY REQUIREMENTS NOT OTHERWISE COVERED ON THIS DRAWING, SEE 173128.

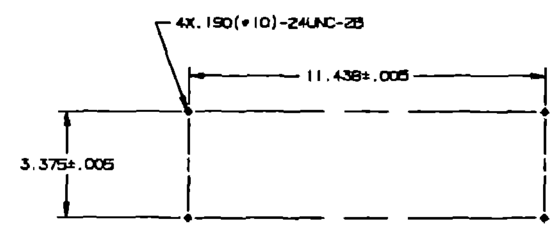
2 MARK (WITH COVER COAT)REFERENCE DESIGNATIONS .50-INCH BLACK CHARACTERS.LOCATE APPROXIMATELY WHERE SHOWN.



DETAIL C,3X



DETAIL B,3X



DETAIL A,3X

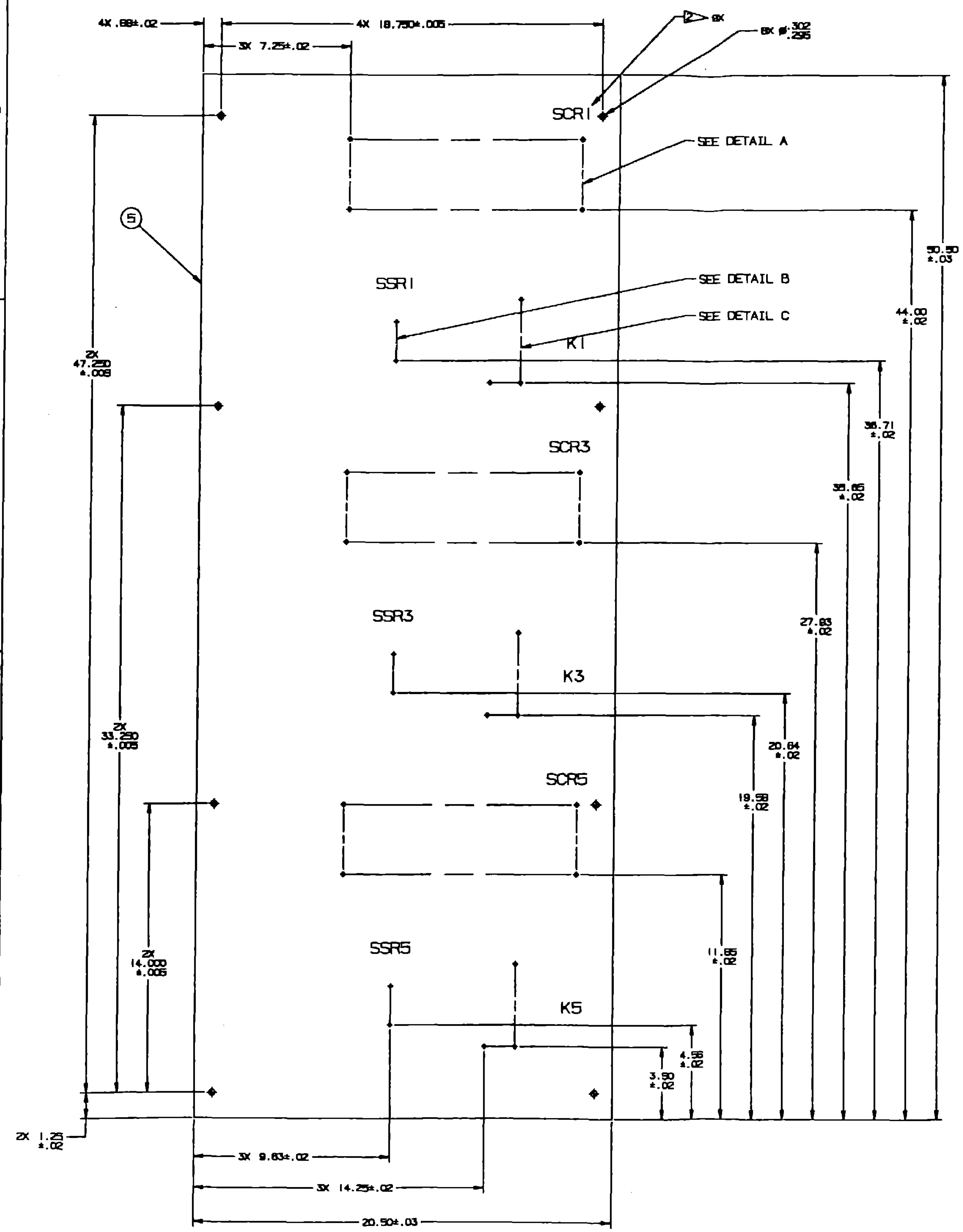
ITEM 10
RIGHT SIDE PANEL
SHEET 1 OF 1

DRAWING NUMBER	UA4972
DRAWING CLASSIFICATION	UNCLASSIFIED
SIZE E	CAGEC 14213 — SCALE 1/2
	ISSUE A — SHEET 9 OF 1
STATUS	SC-REL-5-17-90

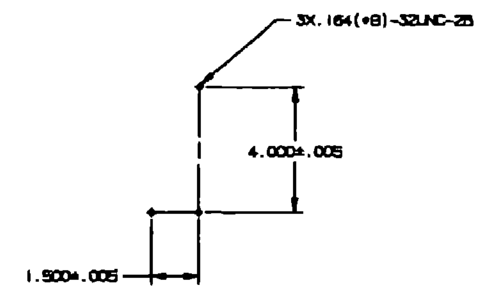
NOTES:

1. FOR SPECIFIC PROCESSING, MANUFACTURING AND ASSEMBLY REQUIREMENTS NOT OTHERWISE COVERED ON THIS DRAWING. SEE 173128.

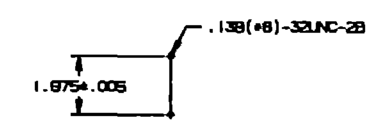
2 MARK (WITH COVER COAT) REFERENCE DESIGNATIONS .50-INCH BLACK CHARACTERS. LOCATE APPROXIMATELY WHERE SHOWN.



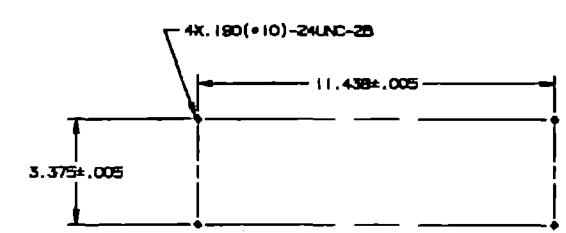
ITEM 11, LEFT SIDE PANEL



DETAIL C, 3X



DETAIL B, 3X



DETAIL A, 3X

ITEM 11
LEFT SIDE PANEL
SHEET 1 OF 1

DRAWING NUMBER	UA4972
DRAWING CLASSIFICATION	UNCLASSIFIED
SIZE E	CAGE 14213 · SCALE 1/
	ISSUE A · SHEET 10
STATUS	SC-REL-5-17-90

Nine Channel Temperature Alarm Interface

Chassis Layout And Electrical Schematics

R23836-000	A	D. DENNEY, 2850/ D. RODRIGUEZ, 2528	B.R.

8. REFERENCE DESIGNATIONS APPEARING WITHIN A SOLID RECTANGLE ARE TO BE MARKED ON BOTH SIDES.

9. ENGRAVE .140/.125 INCH HIGH CONDENSED CHARACTERS, GROOVE WIDTH .025/.020-INCH WIDE, BLACK FILLER. LOCATE APPROXIMATELY AS SHOWN.

10. ENGRAVE LINES .025/.020-INCH WIDE, BLACK FILLER. LOCATE APPROXIMATELY AS SHOWN.

11. UNDERLINED DESIGNATIONS APPEAR ON FRONT PANEL MARKINGS.

12. ENGRAVE .203/.187 INCH HIGH CONDENSED CHARACTERS, GROOVE WIDTH .025/.020-INCH WIDE, BLACK FILLER. LOCATE APPROXIMATELY AS SHOWN.

13. ITEM 11 USED FOR ASSEMBLY OF P1, P2, P3 AND P4

14. ITEM 14 USED FOR ASSEMBLY OF TB1, TB2.

NOTES:

1. FOR SPECIFIC PROCESSING, MANUFACTURING AND ASSEMBLY REQUIREMENTS NOT OTHERWISE COVERED ON THIS DRAWING, SEE 173128.

2. COMPONENTS NOT IDENTIFIED BY ITEM NUMBERS ON THE ASSEMBLY ARE LOCATED IN THE LIST OF MATERIAL BY REFERENCE DESIGNATIONS.

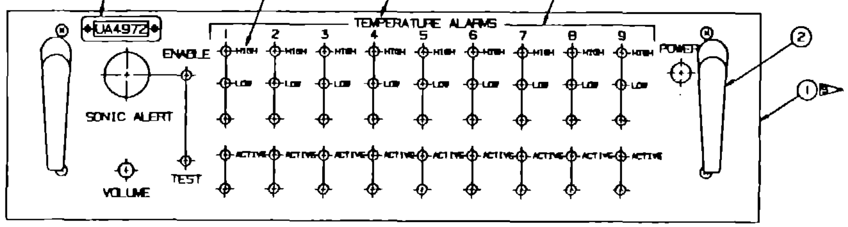
3. USE THIS DIMENSION FOR PRINT INSPECTION MEASUREMENT ONLY. DO NOT USE PRINTS MORE THAN .100 INCH OUT OF SCALE FOR DRILLING TEMPLATES.

4. ENGRAVE .220/.200 INCH HIGH CONDENSED CHARACTERS, GROOVE WIDTH .030/.025 INCH WIDE, BLACK FILLER. LOCATE APPROXIMATELY AS SHOWN.

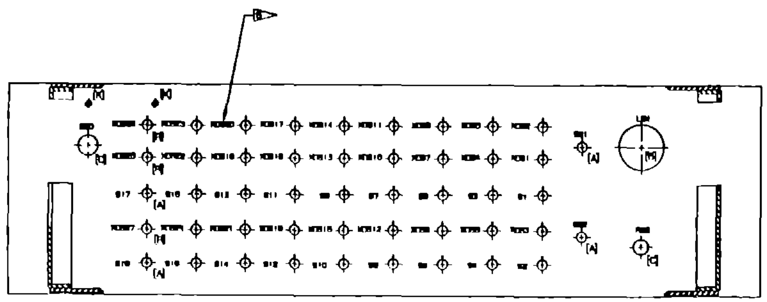
5. CLEAN AND APPLY ALODINE 1200 FINISH PER MIL-C-5541 AND PRIMER ZINC CHROMATE PER TT-P-1757, FOLLOWED BY ENAMEL, MINT GRAY H.P. 6010-0331.

6. MARK (WITH COVER COAT) REFERENCE DESIGNATIONS .120-INCH BLACK CHARACTERS. LOCATE APPROXIMATELY WHERE SHOWN.

7. REFERENCE DESIGNATIONS APPEARING WITHIN A DOTTED RECTANGLE ARE TO BE MARKED ON OPPOSITE SIDE.



FRONT PANEL VIEW



FRONT PANEL "REAR" TEMPLATE VIEW

18.000

18.000

CAD PREPARED TEMPLATE INFORMATION.

1	MB-7	SOCKET, POWER SUPPLY	DATEL		XPS1
2	HRT-2024	SOCKET, RELAY	ARMEL		XK1, XK2
2	357001	FUSEHOLDER	LITTLEFUSE		XF2, XF3
1	342001	FUSEHOLDER	LITTLEFUSE		XF1
10	HCPL-2731	I.C.			U38-U47
1	DC-601A	I.C.			U37
1	5420	I.C.			U34
2	5411	I.C.			U33, 36
1	760-1-R470	I.C., RESISTOR PACK, 470 OHM	CTS		U31
6		I.C., ASSEMBLY			U21, 23, 25, 27, 29, 30
5	5400	I.C.			U20, 22, 24, 26, 28
3	54151	I.C.			U16-U18
6	5474	I.C.			U7-U15
2	5427	I.C.			U8, 19
3	5404	I.C.			U3, 5, 6
4	916C-102-X2PE	I.C., RESISTOR PACK, 1K	SPRAGUE		U1, 2, 4, 32
1	20-141	TERMINAL, BLOCK	TRW		TP2
1	4-141	TERMINAL, BLOCK	TRW		TP1
1	8866K7	SWITCH, TOGGLE, SPDT	CUTLER-HAMMER		S21
1	672	SWITCH, P.B.	OAK		S20
9	8867K4	SWITCH, TOGGLE, DPDT	CUTLER-HAMMER		S12, 14, 16, 18, S2, 4, 6, 8, 10
10	8B3	SWITCH, P.B., SPDT, RED	SWITCHCRAFT		S13, 15, 17, 22, S1, 3, 5, 7, 9, 11
1	70TN200P50L4	RESISTOR, VARIABLE, 5K	A-B		R22
1	RLR07C680GR	RESISTOR, MF, 680 OHM, 1/4 W			R21
20	RLR07C1002GR	RESISTOR, MF, 10K, 1/4 W			R1-R20
1	UPM-5/2000	POWER SUPPLY	DATEL		PS1
4	2-87456-2	CONN., PLUG	AMP		P1-P4
1	SC110P	SIGNAL, AUDIBLE, WARNING	MALLORY		LS1
2	2BR-1738	RELAY	HI-G INC		K1, K2
3	C4-208-N	CONN., RECEPT.	CONTINENTAL		J9-J11
1	6EF1	CONN., RECEPT., AC FILTER	CORCOM		J8
1	108-0902-001	CONN., JACK, BANANA, RED	E.F. JOHNSON		J7
1	108-0903-001	CONN., JACK, BANANA, BLK	E.F. JOHNSON		J6
1	5A1165-1	CONN., RECEPT.			J5
2	ABC 3/4	FUSE, 3/4 AMP, 250V	BUSSMAN		F2, F3
1	MTH-5	FUSE, 5 AMP, 250V	BUSSMAN		F1
27	HLMP-0280	DIODE, LIGHT EMITTING	H.P.		DS1-DS27
1	NPE-WTA100MB6MPC	CAPACITOR, 100 MF, 50V	NC		C21
20	M39014/01-1593	CAPACITOR, CE, .1 MF, 50V			C1-C20
1	80-B4P	BOARD, WIRE-WRAP	AUGAT		A1
					26
6	618-C01	ASSEMBLY, COMPONENT CARRIER, 18 PIN	AUGAT		25
					24
					23
AR	QQ-W-343	WIRE, ELECT., BUS BAR, AWG 14			22
AR	MIL-W-81822	WIRE, ELECT., WIRE-WRAP, AWG 28			21
AR	MIL-W-16878	WIRE, ELECT., TYPE E, AWG 22			20
					19
					18
4	773	TERMINAL, STUD, FORK, 6-32	LITTON IND.		17
3	83	GROMMET, RUBBER, 3/8 I.D.	RUBBERCRAFT		16
					15
24	3/4 W-141	TERMINALS, SOLDER	CINCH	14	14
27	5082-4707	CLIP AND RETAINING RING	H.P.		13
					12
AR	87667-3	PIN, PLUG	AMP	13	11
1	188850-001	PLATE, IDENTIFICATION			10
					9
					8
EM	6010-0331	ENAMEL, BAKING	H.P.		7
EM	MIL-P-8585	PRIMER, ZINC CHROMATE			6
EM	791-BLK	FILLER, BLACK NEW HERMES			5
					4
					3
1	HD-6	HANDLE SET, DOOR ZERO			2
1	D28EW-5-2-3	CHASSIS, ELECT., EQUIP., 5.25 ZERO			1
NA	173128	GEN. SPECS. FOR ACCEPTANCE EQUIPMENT			

SHEET	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
ISSUE	A																				

SHEET	1	2	3	4	5	6
ISSUE	A	A	A	A	A	A

(U) TITLE CLASSIFICATION

CHASSIS, TEMPERATURE ALARMS

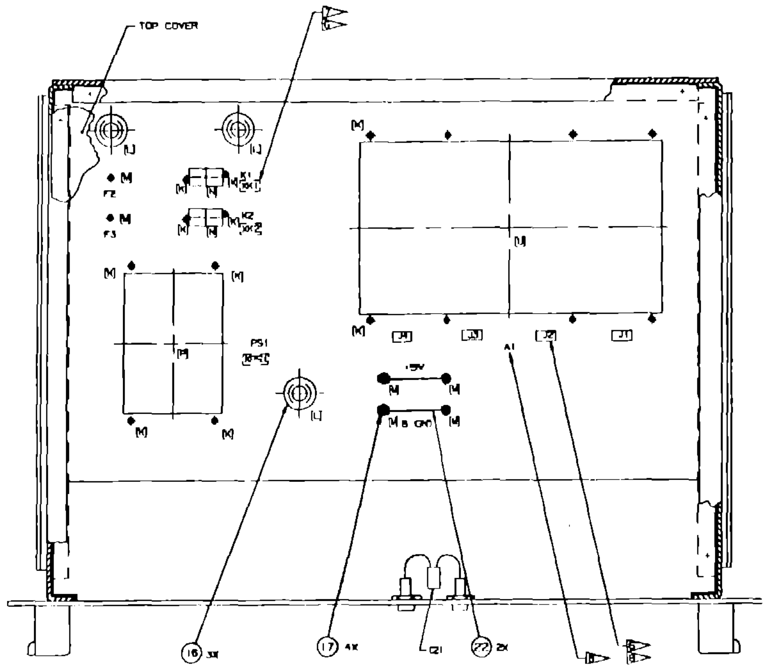
UNCLASSIFIED

UNCLASSIFIED

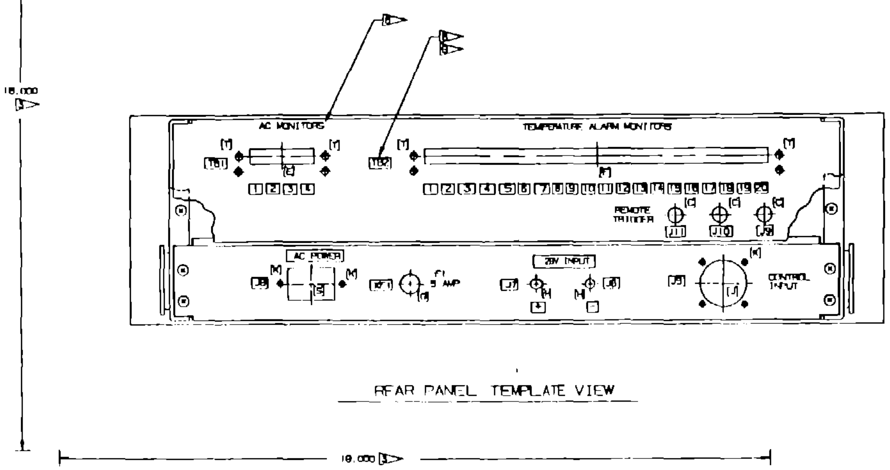
E R23836

CAGE 14213 SCALE 1/1 SHEET 1 OF 7

SC-REL-5-16-7) SC-ANS-V1.2



TOP TEMPLATE VIEW

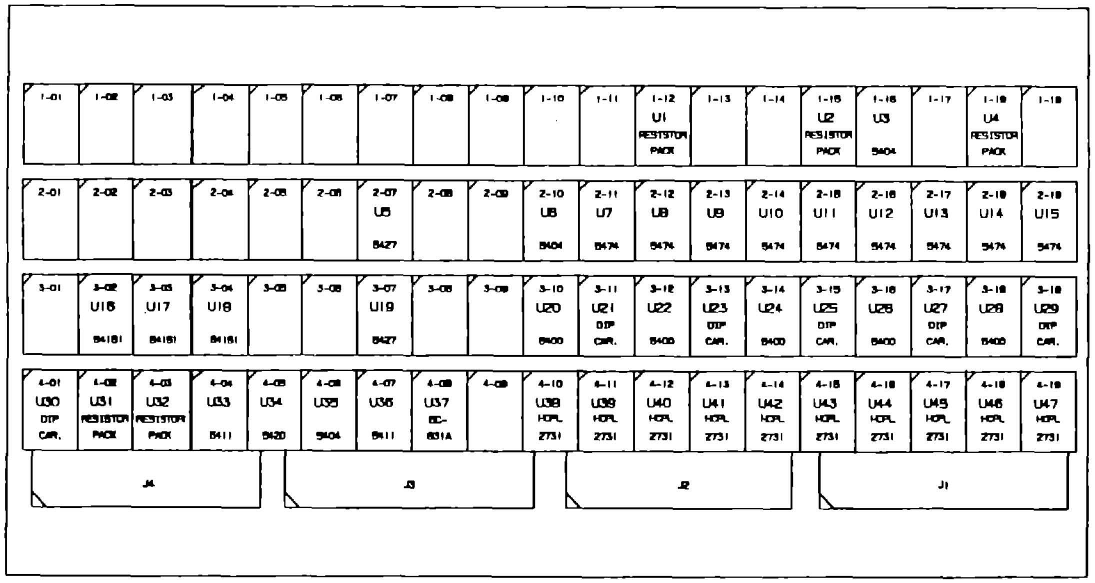


REAR PANEL TEMPLATE VIEW

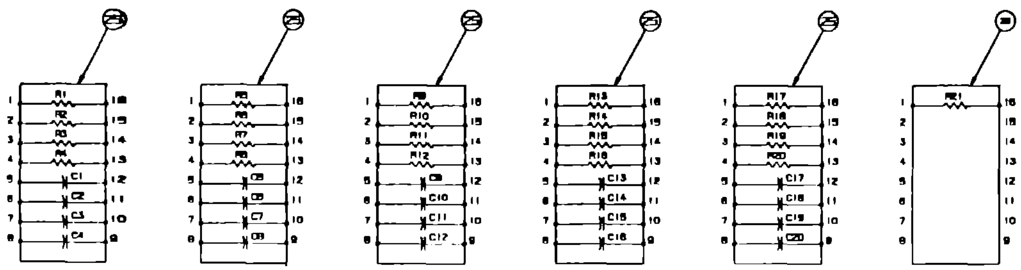
HOLE TABLE			
	DESCRIPTION	QTY	HOW
A	∅ .264/.257	20	
B	∅ 1.140/1.125	1	
C	∅ .380/.375	4	
D	∅ .510/.501	1	
E	CUTOUT 1.625 X .375	1	
F	CUTOUT 0.625 X .375	1	
G	∅ .500 D HOLE	1	
H	∅ .328 D HOLE	2	
J	∅ 1.210/1.180	1	
K	∅ .152/.147	24	4-40
L	∅ .578/.562	3	
M	∅ .145/.140	8	6-32
N	CUTOUT .880 X .430	2	
P	CUTOUT 2.90 X 3.90	1	
R	∅ .249/.242	27	
S	CUTOUT 1.20 X .82	1	
T	∅ .188/.180	8	6-32
U	CUTOUT 7.70 X 4.30	1	

CAD PREPARED TEMPLATE INFORMATION.
CHANGES TO THIS DWG MUST BE MADE BY CAD METHODS TO RETAIN 1/1 SCALE.

DRAWING NUMBER R23836
DRAWING CLASSIFICATION UNCLASSIFIED
SIZE E | CAGE 14213 | SCALE 1/1
TABLE A | SHEET 2 OF 7
STATUS SC-REL-5-16-90



CARD A1

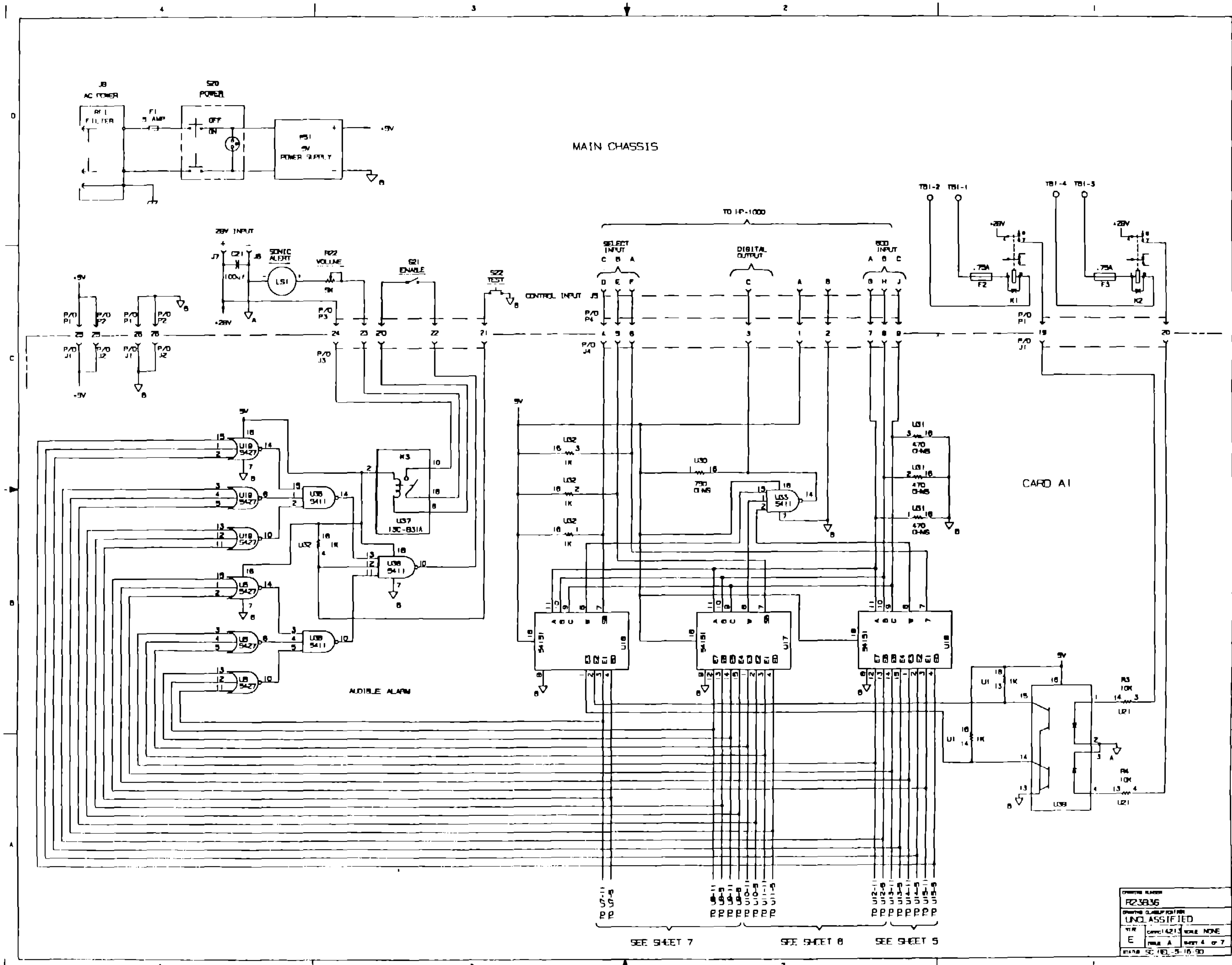


R23836

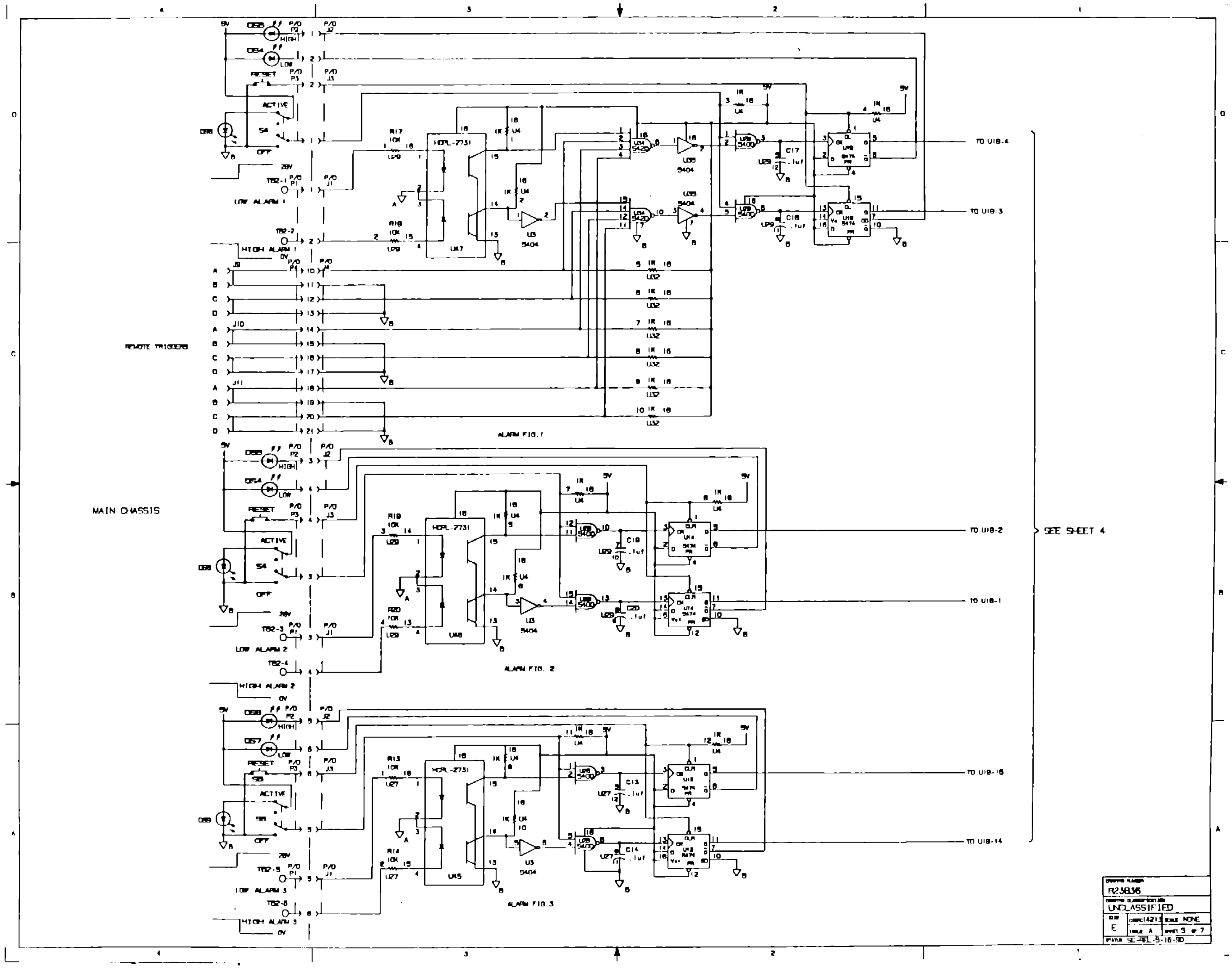
UNCLASSIFIED

E | 14213 | SCALE NONE | A | SHEET 3 OF 7

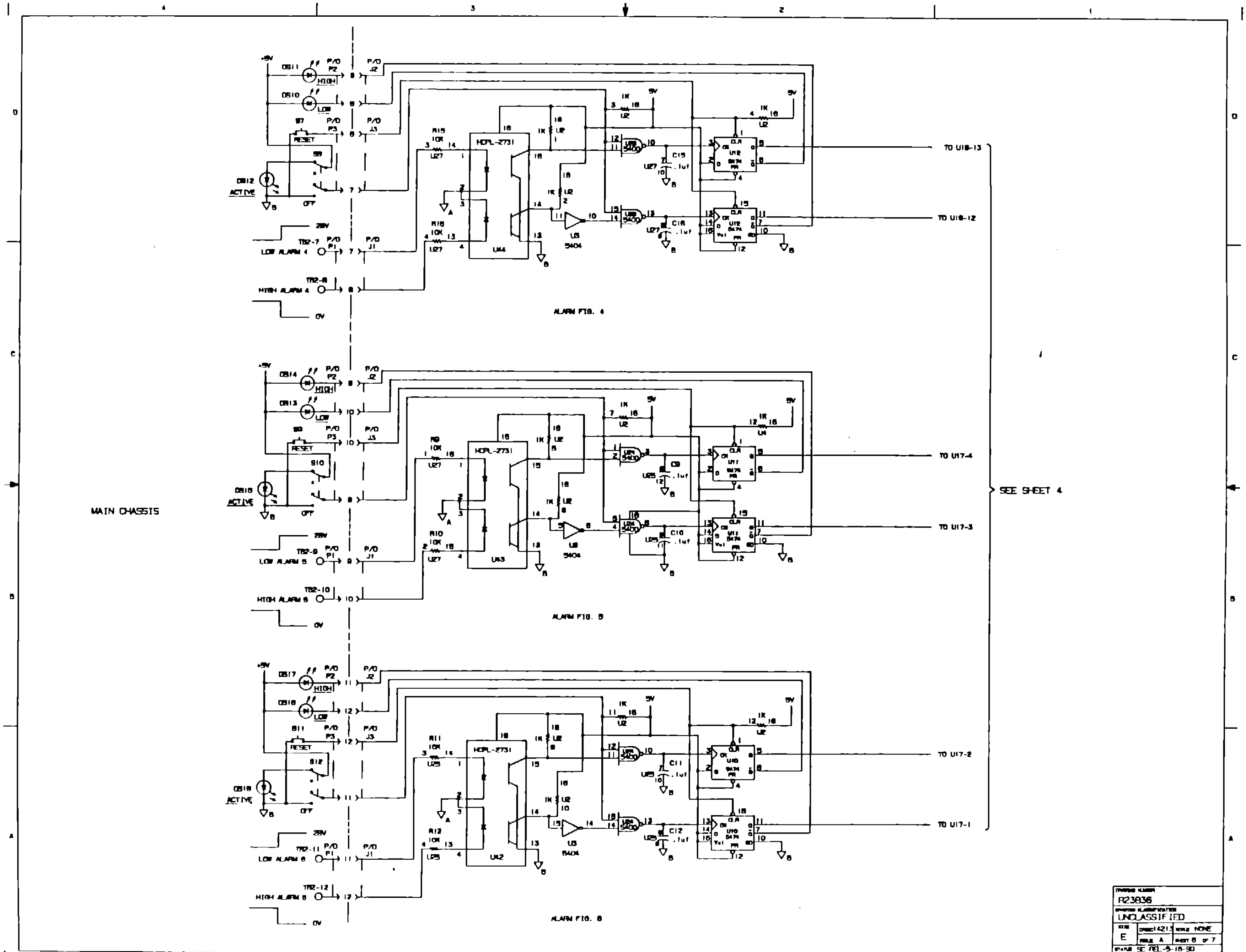
STATUS SC-RB1-5-16-90

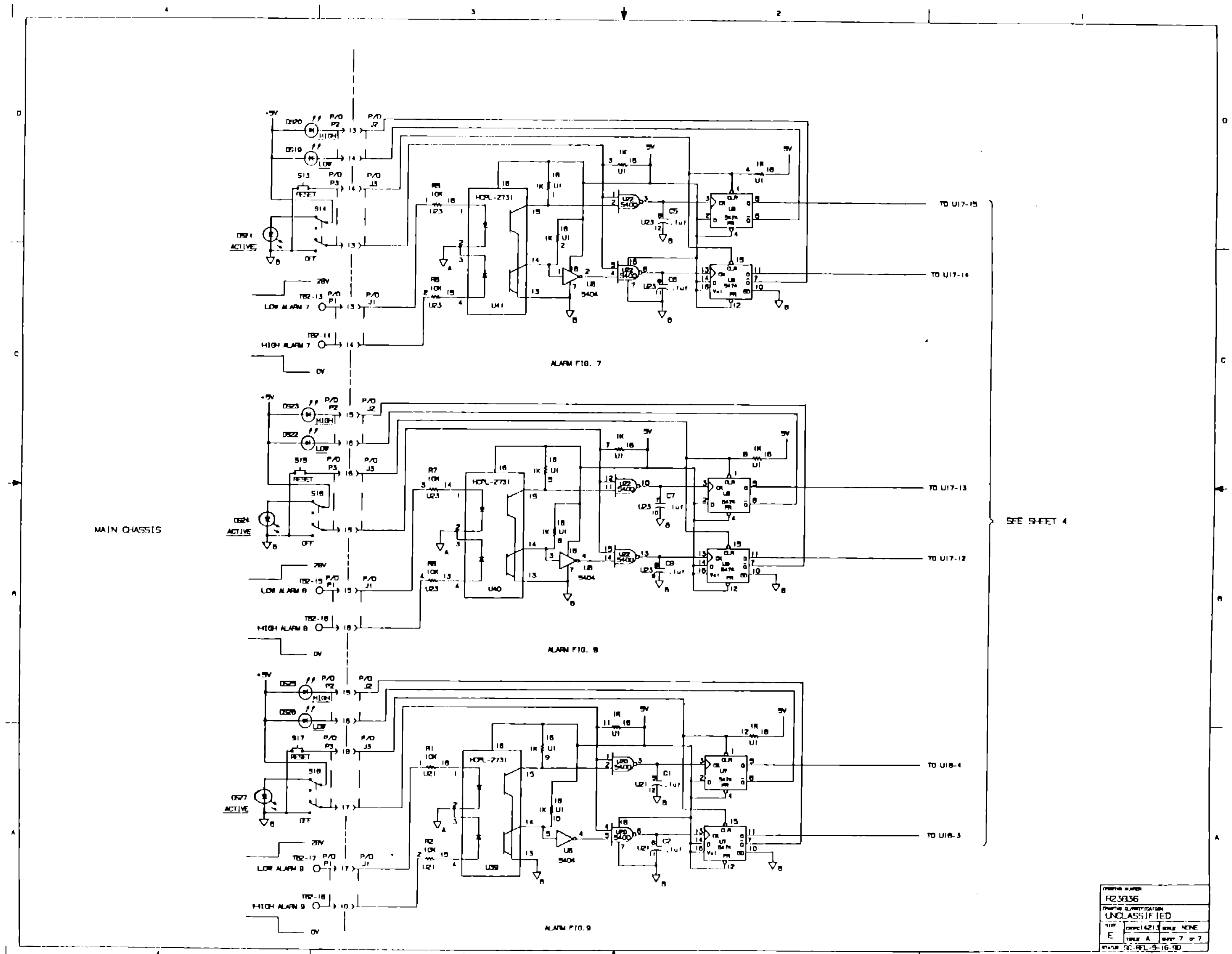


MAIN CHASSIS
CARD A1
AUDIBLE ALARM
TO HP-1000
SELECT INPUT
DIGITAL OUTPUT
BCD INPUT
CONTROL INPUT
AC POWER
RFI FILTER
POWER
5V POWER SUPPLY
28V INPUT
SONIC ALERT
VOLUME
ENABLE
TEST
SEE SHEET 7
SEE SHEET 8
SEE SHEET 5
R23836
UNCLASSIFIED
SCALE NONE
SHEET 4 OF 7



MAIN CHASSIS
REMOTE TRIGGERS
ALARM FIG. 1
ALARM FIG. 2
ALARM FIG. 3
HCPL-2731
LOW ALARM 1
HIGH ALARM 1
LOW ALARM 2
HIGH ALARM 2
LOW ALARM 3
HIGH ALARM 3
RESET
ACTIVE
OFF
TO U18-4
TO U18-3
TO U18-2
TO U18-1
TO U18-15
TO U18-14
SEE SHEET 4
R23836
UNCLASSIFIED
SCALE NONE
SHEET 5 OF 7


MAIN CHASSIS
HIGH
LOW
RESET
ACTIVE
OFF
LOW ALARM 4
HIGH ALARM 4
HCPL-2731
ALARM FIG. 4
TO U18-13
TO U18-12
LOW ALARM 5
HIGH ALARM 5
ALARM FIG. 5
TO U17-4
TO U17-3
SEE SHEET 4
LOW ALARM 6
HIGH ALARM 6
ALARM FIG. 6
TO U17-2
TO U17-1
R23836
UNCLASSIFIED
E
14213
NONE
A
6 OF 7
SC REL-5-18-90


MAIN CHASSIS
ALARM FIG. 7
ALARM FIG. 8
ALARM FIG. 9
SEE SHEET 4
TO U17-15
TO U17-14
TO U17-13
TO U17-12
TO U18-4
TO U18-3
HCPL-2731
LOW ALARM 7
HIGH ALARM 7
LOW ALARM 8
HIGH ALARM 8
LOW ALARM 9
HIGH ALARM 9
RESET
ACTIVE
HIGH
LOW
OFF
28V
0V
+5V
R23836
UNCLASSIFIED
E
SCALE NONE
SHEET 7 OF 7

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